

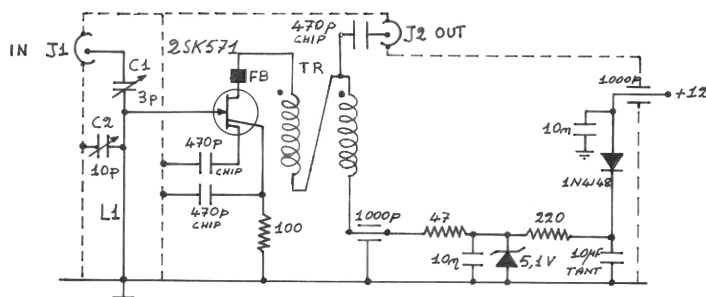
The AMSAT[®] Journal

Volume 36, Number 2

March/April 2013

Editor-in-Chief:
JoAnne Maenpaa, K9JKM

Assistant Editors
Douglas Quagliana, KA2UPW/5
Mike Sedlak, K4ERA
Bernhard Jatzeck, VA6BMJ
Bill Hook, W3QBC



Low Noise Cavity Preamplifier for 70cm EME and Satellites



An Equatorial Antenna Mount - Simple One Axis Tracking

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AMSAT-NA
850 Silver Avenue, Suite 600
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Bequest

A codicil in your will, naming The Radio Amateur Satellite Corporation as a beneficiary will help insure the continuance of the Amateur Radio Satellite program.

Call the AMSAT-NA office at 301-589-6062 for questions on any or all of these ways you can help build new and exciting satellites.

Support AMSAT-NA

AMSAT Announcements

AMSAT Now Preparing for Two Launch Opportunities

AMSAT's focus on STEM education and development of a cubesat platform capable of flying a science mission with a reliable communications link resulted in our previous selection of Fox-1 in the third round and RadFxSat (Fox-1B) in the recent fourth round of NASA's Cubesat Launch Initiative. Actual launch vehicle selections are dependent on the availability of auxiliary payload space and on what orbits are required.

AMSAT VP Engineering Tony Monteiro reports that he has been in conversation with NASA about our orbital preferences/priorities and we're awaiting a response from NASA as to a specific launch selection. In the meantime, the engineering team expects

to complete Fox-1 in 2013 and have RadFxSat ready in the 2nd half of 2014 in order to take advantage of launch opportunities that may be offered by NASA.

AMSAT President Barry Baines, WD4ASW summarized the Fox cubesat program, "Although we are subject to the same launch constraints as every other satellite builder accepted in the Cubesat Launch Initiative, we will be ready for a launch opportunity when it is offered. As soon as we know when we're manifested that information will be shared with our members."

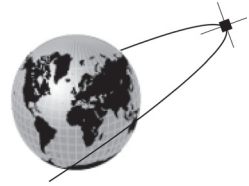
AMSAT's Mission

AMSAT is a non-profit volunteer organization which designs, builds and operates experimental satellites and promotes space education. We work in partnership with government, industry, educational institutions and fellow Amateur Radio societies. We encourage technical and scientific innovation, and promote the training and development of skilled satellite and ground system designers and operators.

AMSAT's Vision

Our Vision is to deploy satellite systems with the goal of providing wide-area and continuous coverage. AMSAT will continue active participation in human space missions and support a stream of LEO satellites developed in cooperation with the educational community and other amateur satellite groups.





Radio Amateur Satellite Corporation (AMSAT-NA)
 850 Sligo Ave., Silver Spring, MD 20910-4703
 Telephone: 301-589-6062 – Toll Free: 888-322-6728
 Facsimile: 301-608-3410
 AMSAT-NA Club Callsign: W3ZM
 AMSAT-NA Web site: <http://www.amsat.org>

The AMSAT Journal Staff

Editor-in-Chief: JoAnne Maenpaa, K9JKM k9jkm@amsat.org

Assistant Editors:

Douglas Quagliana, KA2UPW/5
 Mike Sedlak, K4ERA
 Bernhard Jatzek, VA6BMJ
 Bill Hook, W3QBC

Circulation: Martha Saragovitz, martha@amsat.org

AMSAT-NA Board of Directors

Barry Baines, WD4ASW, wd4asw@amsat.org

Alan Biddle, WA4SCA, wa4sca@amsat.org

Tom Clark, K3IO, k3io@amsat.org

Drew Glasbrenner, KO4MA, ko4ma@amsat.org

Lou McFadin, W5DID, w5did@amsat.org

Tony Monteiro, AA2TX, aa2tx@amsat.org

Gould Smith, WA4SXM, wa4sxm@amsat.org

First Alternate: **Mark Hammond**, N8MH, n8mh@amsat.org

Second Alternate: **Patrick Stoddard**, WD9EWK, wd9ewk@amsat.org

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Editorial Office: JoAnne Maenpaa K9JKM, 608 Hawthorne Lane, Carpentersville, IL 60110. Please e-mail Journal submissions to: journal@amsat.org, Editor's telephone: 847-239-2286 (cell). **Advertising Office:** AMSAT-NA Headquarters, 850 Sligo Avenue, Suite 600, Silver Spring, MD 20910-4703, Telephone: 301-589-6062.

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AMSAT's RadFxCat (Fox-1B) Cubesat

AMSAT was notified on 26 FEB 13 by NASA that our proposal to fly a radiation experiment developed by Vanderbilt University's Institute for Space and Defense Electronics (ISDE) married to a Fox-1 spacecraft had been accepted. This is our second satellite to be accepted under NASA's CubeSat Launch Initiative. Projects accepted under this program selection are expected to fly as secondary payloads in the 2014-2015-2016 timeframe.

From an amateur radio perspective, this satellite will feature identical capabilities as Fox-1, including fulltime operation of the amateur radio repeater. Telemetry from the radiation experiment will be transmitted simultaneously with voice communications using a low speed data rate that uses sub-audible tones.

RadFxCat is an example of AMSAT partnering with a major university to develop a science payload that provides the justification for NASA to provide a launch opportunity. Vanderbilt benefits from AMSAT's expertise in spacecraft design and construction as well as our RF design that supports their needs as well as the needs of amateur radio in space. This allows Vanderbilt to focus on developing the payload while AMSAT focuses on developing the spacecraft.

Virginia Tech Collaboration Agreement

Meanwhile, AMSAT signed a collaboration agreement with Virginia Polytechnic Institute and State University on 4 FEB 13 that establishes a relationship for future projects in the development of space hardware, software, algorithms, documentation of same and an agreement to protect each other by protecting ITAR-covered materials and identifying same for the other. I signed the agreement on behalf of AMSAT while Virginia Tech Assistant Vice President for Sponsored Programs Administration John Rudd signed on behalf of the university.

The Agreement establishes a relationship

that will allow both organizations to work together on future space mission opportunities as they may arise. VT established the Center for Space Science and Engineering (Space@VT) in 2007 and with completion of the new Center for Space Science and Engineering Research Facility in 2012, has facilities for development of space hardware and cubesat development. Programmatic and technical coordination and direction will be coordinated between Dr. Robert W. McGwier, PhD of Virginia Tech and Anthony Monteiro, AA2TX AMSAT's VP-Engineering.

As I noted in the ANS Bulletin that announced the agreement, "Establishment of a formal relationship between VT and AMSAT provides the foundation for potential future satellite program opportunities for AMSAT as well as enhances prospects for AMSAT support of STEM (Science, Technology, Engineering and Mathematics) education outreach. Space@VT recognizes the success that AMSAT brings to building successful spacecraft and with the development of Fox-1, to bring reliable hardware in support of scientific payloads as well as enhance prospects for student projects to successfully fly in space. AMSAT benefits from a partner that will help provide justification for funding of spacecraft that supports amateur radio in space."

The ANS Bulletin also noted the benefits of the agreement to Virginia Tech. Virginia Tech Professor Bob McGwier, N4HY is looking forward to working with AMSAT on future projects. At the time the Agreement was signed, Bob remarked, "Being able to combine the student space science and engineering programs of Virginia Tech with AMSAT's long history of innovative technical development in spacecraft is a win-win for both parties. I look forward to working with AMSAT on projects that mutually benefit space science, student engineering programs, and the amateur radio community."

One immediate result of this evolving relationship with VT is that students at VT have developed a camera module that will be added to the Fox-1 spacecraft. At Dayton, you will see the addition in the drawings of the Fox-1 design on display and general information concerning this new modification will be presented at the AMSAT Forum.

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Dayton Hamvention

Amateur Radio's premier North American event takes place the weekend of May 18 at the Hara Arena in Dayton. AMSAT preparations are in full swing. Here is a brief outline of key events. Updates are being placed on the AMSAT website (www.amsat.org) in the "AMSAT at Dayton Hamvention 2013" tab and through AMSAT News Service (ANS) Bulletins.

AMSAT's theme this year is "AMSAT: A View to the Future" highlighting our plans for construction and subsequent launch of Fox-1 and the announcement last month that our RadFxSat/Fox-1B proposal submitted in partnership with Vanderbilt University's Institute for Space and Defense Electronics (ISDE) has been accepted by NASA. AMSAT is now committed to two satellite projects which will provide FM single channel satellite capability. Our expectation is that the Fox-1 design, once proven in space, will provide a platform that will allow us to expand our partnerships with university programs. As already noted, prospects for subsidized flights are enhanced when the spacecraft provides benefits beyond the ability of amateur radio operators to communicate through spacecraft. Adding payloads that enhance scientific research is the driver for providing launch opportunities for AMSAT.

AMSAT's Dayton participation is being led by Steve Belter, N9IP who has agreed to coordinate our activities as AMSAT VP-Gould Smith, WA4SXM has medical issues that preclude his involvement this year. Steve has been an AMSAT volunteer at Hamvention in prior years and is familiar with our activities. Volunteers are needed to assist with manning the AMSAT booth, so if you're interested in assisting our efforts at Dayton, please contact Steve (n9ip@amsat.org).

Our six-booth location is in the same area as prior years, but the layout configuration has changed. This year we'll have AMSAT's three booths across from AMSAT's three booths, creating an "AMSAT Section" with a cross-aisle at each end. The current plan is to have the engineering booth display area and the software display area on one side and the general display and membership area on the other side. Engineering will have Fox-1 associated materials on display. The general display will feature the latest in AMSAT "fashions" along with our books and other materials available for donation. Please stop by and say "hello" to Martha and the AMSAT leadership.

Thursday night will feature our annual informal get-together at Tickets Pub and Eatery in Fairborn from 1830- until ?. Hamvention opens at 0900 Friday morning and closes at 1800. The annual joint AMSAT-TAPR dinner will take place starting at 1830 at the same venue used recently: Kohler Presidential Banquet Center in Kettering, OH. Directions to this facility (4548 Presidential Way) will be available at the AMSAT Booth.

TAPR has arranged for this year's banquet presentation: "The Evangelist's Dilemma: Driving New Ideas With Nothing But Words". As TAPR President Steve Bible, N7HPR has noted, "Bruce Perens, K6BP, presents a humorous history of technology evangelism and the things that inevitably go wrong, drawing from his history with Open Source, No-Code, Software Freedom, Codec2, and Open Hardware, and introducing a few of the new battle grounds."

Reservations for the Dinner are REQUIRED and must be made by Thursday, 16 MAY via the AMSAT Store. Cost is \$30.00/person. Last year we sold out, so please don't defer making your reservation for this year's event.

Hamvention hours on Saturday are from 0800-1700 and will feature the AMSAT Forum which takes place at 1115-1330 in Forum Room 5. This is the same location and time as last year's forum with the forum moderated by Alan Biddle, WA4SCA. Scheduled presentations include:

- "AMSAT Status Report." Barry Baines, WD4ASW, AMSAT-NA President
- "A report on ARISS." Frank Bauer, KA3HDO, AMSAT-NA VP for Human Spaceflight
- "AMSAT Fox Satellite Program," Tony Monteiro, AA2TX, AMSAT-NA VP-Engineering
- "The AMSAT-UK FUNcube CubeSat." Howard Long, G6LVB, AMSAT-UK Committee Member
- "Amateur Satellites, Education, and You!" Mark Hammond, N8MH, AMSAT-NA VP-Educational Relations

The AMSAT Forum is an excellent opportunity to learn about AMSAT projects and developments. Having Howard Long, G6LVB at Dayton to present on AMSAT-UK's FUNcube Program is also significant given that the satellite is scheduled to be launched later this year. Along with the AMSAT Forum, Hamvention offers you

a great venue to meet with the AMSAT Leadership, including the BoD members and the Senior Officers as most of the leadership team will be present at Hamvention. If you have questions or want to express your thoughts about AMSAT, here is your chance to interact directly with AMSAT's leadership team.

On Sunday, the Hamvention runs from 0800-1300. During all three days, we will have the "Satellite Demonstration Area" manned by Keith Pugh, W5IU and his team of volunteers working the satellites. Stop by the AMSAT booth for times of the various satellite passes and take the time to check out the demos. If you have any questions about operating through the satellites, this is an opportunity to have your questions answered by those who are well experienced in working contacts through satellites.

ITAR

In my prior "Apogee View" column I noted recent developments regarding International Traffic in Arms Regulations (ITAR). This issue of *The AMSAT Journal* also contains an article that I've written in response to some reports in the amateur radio press that suggest that ITAR is no longer in effect for amateur radio satellites. This is certainly not the case; until the new procedures are implemented, AMSAT-NA continues to be subject to the current ITAR regulations. Please review this article for details. AMSAT Congressional Liaison Peter Portanova, WB2OQQ is monitoring regulatory developments that impact how changes to ITAR will be implemented.

University Cubesat Programs

Over the past several months events have caused the Federal Communications Commission's (FCC) to more closely evaluate whether many of the small satellite projects proposed for launch should continue to be operated as stations in the Amateur-Satellite Service or instead be licensed as experimental stations. Based on the FCC's review, they determined that many do not really fit as Amateur projects and instead are requiring that the satellite developers obtain experimental licenses while still allowing them to operate in bands allocated to the Amateur-Satellite Service.

This has generated concern by the International Amateur Radio Union (IARU) with regard to whether it is appropriate for their Satellite Advisory Panel to take on the duty of coordinating what the FCC now

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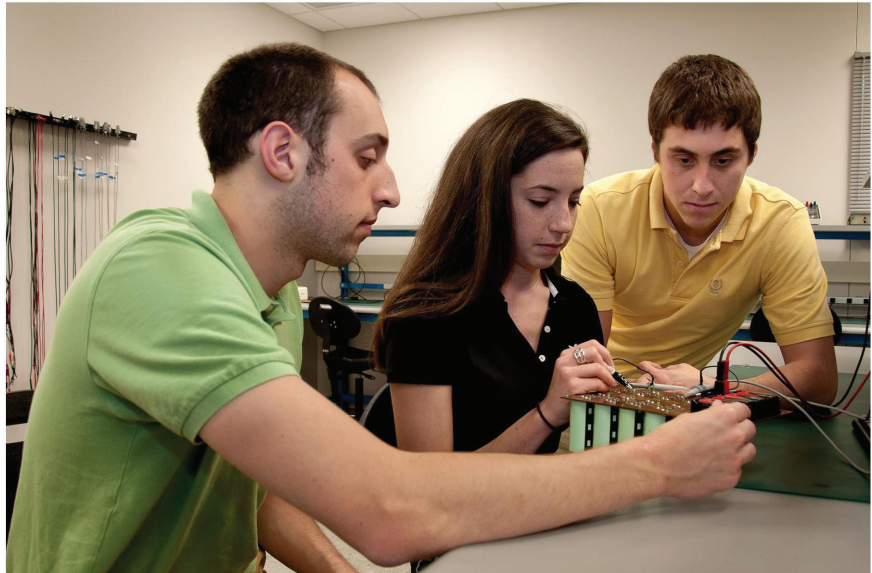
Tony Monteiro, AA2TX
aa2tx@amsat.org

During the 2011 - 2012 academic year, AMSAT sponsored a Senior Design project at The Behrend College of Penn State University. This goal of the project was to have students develop a prototype energy storage device that could be used as a replacement for the battery used on ARISSat-1. As most of you probably know, the 825M3 Russian Space Suit battery used on the ARISSat-1 satellite was not designed for long-term operations. These batteries are rated for just five charge/discharge cycles to support five extra-vehicular activity (EVA) missions. In use on ARISSat-1, they were subjected to 16 charge/discharge cycles per orbit which is well beyond their intended use. Due to the circumstances associated with the launch and deployment from the ISS, this battery was required to be used on ARISSat-1. It operated for about one week on-orbit before failing. However, AMSAT would like to have a better solution for energy storage if we have the opportunity to launch another ARISSat type satellite.

Since this is a research project rather than an immediate development need, AMSAT contacted Penn State University to see if students would be interested in working on this problem. Three students from The Behrend College at the Erie campus took up this challenge and worked on this as a for-credit senior capstone project. Their work was intended to focus on an energy storage battery replacement based on supercapacitor technology. This technology has exceedingly high charge/discharge cycle capabilities which would provide a long life on-orbit. An ARISSat type satellite would generally be expected to de-orbit long before the supercapacitor-based battery would fail.

In a previous AMSAT-sponsored senior design project, students at SUNY Binghamton, tested the supercapacitors to see if they could survive some of the harsh conditions that the satellite would see in space including vacuum testing. The parts were tested and all worked as expected. This new project continued and built on the previous work at SUNY and allowed a complete working "drop-in" replacement battery to be constructed.

This project was sponsored by AMSAT with Tony Monteiro, AA2TX, and Lou McFadin, W5DID, mentoring the students as technical advisors. Another AMSAT member, Alex Harvilchuck, N3NP, served as the AMSAT liaison with Penn State.



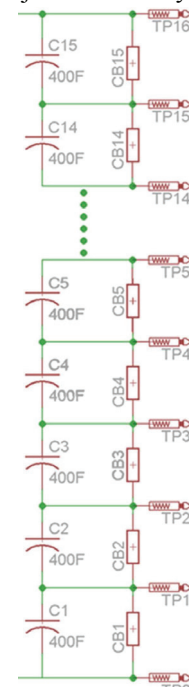
Penn State Students Jacob Sherk, Kathleen Nicholas and David Jesberger test their prototype supercapacitor-based battery. Photo courtesy of Penn State University.

The students were David Jesberger, of St. Mary's, Kathleen Nicholas, of Pittsburgh and Jacob Sherk, of Elizabethtown. Their faculty advisor was Dr. Dakshina Murthy Bellur, an assistant professor of electrical and computer engineering at Penn State Behrend.

The students were provided with all of the technical documentation available on the ARISSat-1 power system and the known parameters of the battery. Since the 825M3 battery was of a proprietary Russian design, there was only limited technical information available. Nonetheless, the mission needs for another ARISSat mission were well known and this was helpful in sizing and testing the prototype. In order to save some costs, the final energy storage capacity was slightly lower than what would be needed to run the satellite in its high power mode through the entire eclipse period. Nonetheless, this would just require somewhat larger supercapacitor devices with no change in the design concept. The student's final report, showing the outstanding depth of analysis and investigation that the students provided, will be published in an upcoming issue of *The AMSAT Journal*.

This prototype project demonstrated that a supercapacitor-based battery could be adapted for use on a future ARISSat mission. We would seriously consider doing this although a key issue that would need to be addressed would be the flammability of the supercapacitors since an ISS deploy would be a manned space mission. Unfortunately,

the energy density/volume and mass/power ratios are not sufficiently advanced at this time on supercapacitors to be able to use them as a battery replacement on a CubeSat mission. However, since these components show much promise in harsh environments, we will be monitoring their progress carefully. The author is happy to add a note that all three students successfully graduated and got good jobs in industry. 🌐



Supercapacitor bank design has fifteen 400 Farad supercapacitors in series to provide 36 volts at 4.8 watt hours.



Hector L. Martinez, CO6CBF, co6cbf@amsat.org

Since I heard about SuitSat-1 from the National Television of my country, I was encouraged to research about it, about ARISS and space communications in general. I had not heard about this part of our hobby before. I was really surprised when I discovered the great amateur radio activity that exists in space. At that time, I was 15 years old and was studying at the Electronic Technician school of my city. I got my first radio license at 11 years old as CL9CBF, and built my first 160m transceiver following the instructions from Raul, CO6GB - a radio operator of my Radio Club. I was very active on 160m.

The only radio available for satellites was a broken 2m Yaesu FT-23R HT which my grandfather bought for me. I fixed it, following the instructions from Javier CM6WB - another ham of my Radio Club. I tried to receive SuitSat-1 using this radio and a homebrew 6-element Yagi which I made to operate through the local repeaters. As I had been studying about antennas for satellites, I bent the Yagi's boom skyward and moved the small tower in front of my shack's window, ready to point it by hand through the window.

At the same time, I was trying to build my first PC computer with recycled parts. It was ready for SuitSat-1, running an unregistered version of WXtrack on Windows 98. Despite not hearing anything from the spacecraft, it was a great experience for me. Looking for information about it, I learned about the marvelous world of AMSAT and the space projects which involved amateur radio. I built the interface to connect the FT-23R to the computer and made everything to work



Since I heard about SuitSat-1 I was encouraged to research about it, about ARISS and space communications ...

the ISS digipeater. The first signal seen on the screen was from YV6BFE. I also tried to receive the meteorological pictures from the NOAA weather satellites. After some weeks, I had the first contact with the International Space Station's crew. An unforgettable moment in my life!

At that time, I kept in my mind that operating through the Satellite transponders was impossible for me. I never had seen any 70cm radio, or any UHF homebrew radio project. I had not known any satellite operator in my country either.

My first satellite setup

When I finished the technician school, I began to work as an electronics technician. I had my own email and an Internet account. I continued looking for any 70cm radio or any UHF scanner, but it has been really difficult for me to find one. There are no shops or RadioShack stores available to buy anything related to amateur radio.

I found some 70cm downconverter designs online, and asked for help in some email lists about any other designs in order to choose the most complete and achievable project. This one came from Bill NZ5N who sent me a project published in the March 1983 QST by John W6IOJ. It is a great project with a detailed "Know How"! As the project doesn't require highly sophisticated test equipment for alignment, the article itself shows how to build the needed test equipment. Even though this was written in 1983, it was still relevant for me. While there are plenty of high performance downconverters, most of the parts required to build them are not available in my country. It was just what I was looking for!

I constructed everything carefully as John described, beginning with the test equipment. All the electronic parts were found in my "junk box" and in a broken Yaesu FTC-2640 2m radio. I did not have a printed circuit board to make the circuits, so I built it in three TV tuner boxes without circuit board. I used a box for each module: local oscillator, mixer and RF-amplifier. This method made the project very easy to assemble. It was my first UHF homebrew construction, and I cannot say how satisfied I was when I tested each module and everything worked properly.

I had thought in antennas too. While I was working on the converter, my grandfather

- who is a smart mechanic - was building some pieces to rebuild a blood pump's motor reducer from a discontinued dialysis machine. We used it as the main part for the azimuth rotor. I designed the circuits for the position reference and the remote control box. The rotor control box was constructed into a FAX modem case.

I designed two circularly-polarized Yagis, 18 elements for UHF and 10 elements for VHF. I simulated and optimized these in software called MMANA, and the project was ready to be built. The calculations were done for the parts that I had in my "junk box". I used 30mm PVC pipe for the booms, and for the elements 4mm aluminum wire. The transmission lines were RG-58 coaxial cable.

The rotor and antennas were assembled in my backyard at four feet over the ground to test its performance before going on the roof. The system was tested and it worked as it was expected. So, I had everything ready for the "smoke test", my first satellite contact. My first satellite contact was on January 27, 2011, with John K8YSE on AO-51. Another unforgettable moment in my life! After that, I spent around two months working on the tower and the UHF preamplifier. I chose a mast-mounted DF9CY preamplifier design and I built it into a TV splitter case. It was tested with the same equipment built for



The first radio needed repairs ...

aligning the converter.

We installed the rotor, antennas and preamplifier on the tower. Since that moment, I have been on satellites almost every day!

First portable operation

After about a year on the FM birds, I obtained the first satellite VUCC in my country and other AMSAT awards. This was a great accomplishment for me. While I was very active on satellites from home, I was improving my FM setup until I could carry it in my backpack. I constructed a YO3BAL 70cm/2m downconverter, which spent a long time at the workbench due to the poor description of the design I had and the inappropriate circuit board material I used. Finally, I got it performing properly, but it did not perform as well as my 70cm/10m converter.

I rebuilt an SSB HF receiver which I made for other uses as a FM 10m receiver. I tried to reduce the weight and size as much as I could. When the work was finished I tested it together with the 70cm/10m converter. Its performance was very good.

In August 2011, my brother Franklin CL6BFC, my girlfriend, and I planned a vacation trip to Trinidad city and Rio Hondo. I thought it would be a great opportunity to do the “smoke test” with my portable setup and activate a rare grid square. I made an IOio antenna and tested the system form home trying to receive AO-51 running both configurations:

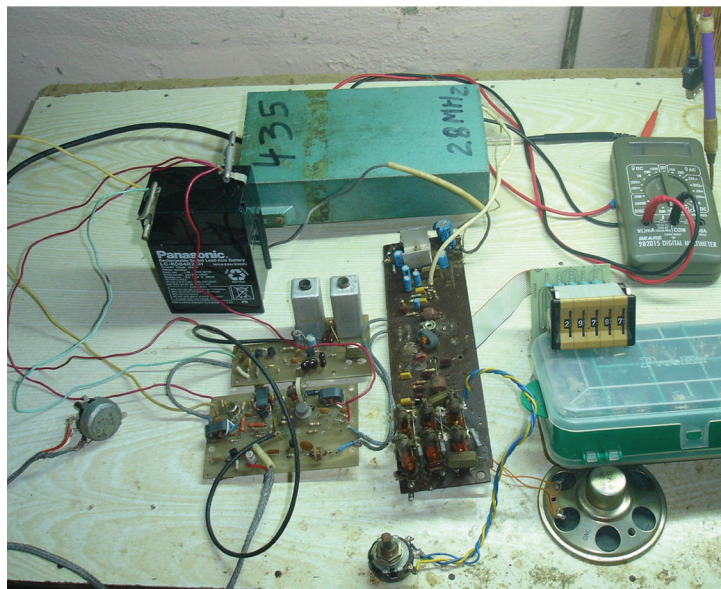
- IOio antenna, 70cm/2m downconverter, 2m HT
- IOio antenna, 70cm/10m downconverter, HF receiver.

The second configuration worked better, but it was a little more complicated to use without any assistance.

Finally, I carried the two configurations and a 12V 7A gel-cell battery to power the system. It was my first portable operation on satellites, and it was fantastic. I operated from the EL91/FL01 grid boundary, and used both configurations. During the very early morning AO-51 passes around 5:30 AM, I woke up and used the first configuration with limited RX capabilities. During the afternoon passes, I used the better gear with the assistance of my brother and my girlfriend. We had 20 contacts in four AO-51 passes, and we operated from two grids never activated on satellites!



Hector's homebrew computer



Homebrew 70cm to 28 MHz converter



Completed homebrew 70cm to 28 MHz converter

SSB Satellite Setup

Since I set my eyes on the linear birds, I had been looking for any 2m multimode radio. Once again, it has been really difficult to find one.

I tried to convert an old 2m FM transceiver into a CW transmitter. I disconnected the MIC preamplifier circuit, I kept the TX activated, and switched the RF drive transistor by a switch circuit added and commanded by the CW key. The experiment worked successfully, and I had my first contact on AO-7 mode A on April 24, 2011, with Gary K4MF.

Thinking about something more serious, I began to find information about any homebrew SSB 2m transceiver or transverter project to complete my gear for the linear birds. I found some interesting and detailed projects online from Gaetan ON4KHG and Janne OH1SDR, but most of the parts required to build them are not available in my country.

The most achievable 2m transverter project came from Manuel CX9BT. He designed and constructed it for EME purposes. The project looked wonderful, and I had the opportunity to chat directly with him by email and radio on the 10m band. The project required some specific parts: the MC145151 synthesizer, the SP4541 prescaler, the PIN diodes, the mixer DBL, the 5W Hybrid Power Amplifier, some GaAsFETs, and some dual-gate FETs which are not available in my country. Manuel sent me all these parts and some others for future projects!

I started to construct the transverter and was testing circuit by circuit as Manuel was telling me. It was really difficult for me to fix the synthesizer exactly at 116.00 MHz. The project was constructed in a discontinued PH meter laboratory instrument case. When the transverter was finished and aligned I did the "smoke test" on FO-29. My first contact was on January 31, 2012, with Robert, AK5V.

When I finished the transverter, I listened for VO-52 and I was surprised with the great signals coming from the transponder and beacon. I was encouraged to work on another project to add the transmission stages for my first 70cm/10m down converter. I had to modify the original project but it was not difficult as the main part was done before. I modified the same CX9BT design with some references taken from the JF1OZL 70 cm transceiver project. I built the switch stages, attenuation stage, bandpass filter, and power

amplifier. The majority of the electronic parts were found in my "junk box". The few remaining items like high Q trimmers and high frequency low-noise transistors impossible to find here, were donated for Bill, W3XS.

I had my first contact on VO-52 on February 28, 2012, with Walter, WP4T. I was running around a watt, and Walter gave me 57!

Current satellite gear and future projects

In order to improve the Intermediate frequency stability for the transverters, I bought a Yaesu FT-757GXII in good shape but with some transmission issues. I researched it and looked for any assistance in the Fox Tango International web site. In this occasion the help came from Carol W4CLM and David W6NFU. I substituted all the switching diodes in the RF board as they told me, but the problem with the RF power continued. So I decided to substitute the TX mixer IC (ND487) which has four diodes. I matched four BAT 41 diodes and connected these under the circuit board to try the RF power level again. Fortunately, the radio was fixed! It is my first commercially-made Ham radio!

When I am at home, I combine the 757 with my homebrew transverters which is a great advance among my homebrew HF transceivers. Now I am able to tune FM in 2.5 kHz steps, which is a great help to receive SO-50.

My local area is very hot. I live in the city, which has a lot of buildings with amateur, broadcasting, repeaters and other stations. So I constructed a cavity preamplifier which Domenico I8CVS described in a great Italian article. Before that, I had TV interference on the downlinks of SO-50 and AO-27. When I began to use the preamplifier, the interference disappeared. It allows me an excellent full-duplex capability without desense problems.

In order to handle my portable gear easier, I found a great solution - I installed the YO3BAL 70cm/2m downconverter inside a mobile 2m radio that had a damaged transmitter. I removed it, and then installed the downconverter. Now it is easier to operate from anywhere, I hold the 2m FM mobile radio with a strap around my neck, the HT in one hand and the homebrew Arrow antenna with preamplifier in the other hand. I use a 2m Kenwood TK-270 handie talkie for transmitting, a 12V 7A gel-cell battery

into a backpack to power up everything, plus a portable digital MP3 recorder to log the contacts.

I tested some preamplifiers on my homebrew ARROW antenna including a PR40 kit that was donated by Omar XE1AO. The preamplifier on the ARROW improved my capabilities to receive the satellites during my portable operations. I worked Yuri UT1FG/MM on AO-27 with under a degree of elevation!

I am preparing to improve my station to work FO-29 on the horizon. Cubans cannot operate on the 432 MHz (AO-7's uplink). So FO-29 is the only chance to reach long distances on the satellites. I am constructing a 2m 50W linear PA and two long Yagis like M2's 2MCP14 and 436CP30. I am trying to add the elevation capabilities to my homebrew rotator, keeping in mind the local availability of pieces that we recycle from many sources. I plan to install the antennas at 95 feet on a nearby building.

I have spent a long time at the workbench constructing my gear for satellites. It has been a really long time, but I have enjoyed it!

I have worked 49 of 50 US states, and 487 grids squares. I have operated from six Cuban grid squares (EL83, EL91, EL92, EL93, FL01 and FL02) most of them have never been active on the satellites. In less than 2 years on satellites, I can see 4460 contacts in my log!

Here in Cuba, there are only a few satellite operators. The amateur satellites are a strange world for the majority of Cuban hams. In order to promote Amateur Radio by Satellite, we formed the first Cuban Satellite Group (GROS). We are trying to encourage operators to join us on this fascinating ride. We have done several satellite presentations from radio clubs, universities, high schools, and parks. We have won a lot of satellite enthusiasts. My hope is not only involving more hams on satellites, but motivating young people today towards careers in science, math and technology. I will never forget my first time hearing myself on the transponder downlink. Even though it was almost two years ago, my heart is still excited when I hear myself on the downlink!

I want to say "thanks" to all my friends who have helped my satellite career. I am very fortunate to have known each of you. I truly appreciate your assistance, advice, help and friendship in general! Thanks so much my friends! ☺





Homebrew rotor control box



Hector gave his presentation "Working Satellites With a Homebrew Setup: Cuban Style" at the AMSAT 2012 Space Symposium in Orlando, Florida.



Homebrew satellite antennas and rotor at CO6CBF



Hector giving a satellite demonstration from the sea walk in his hometown in Cuba.

2013 Amateur Transponder Launch Opportunity Summary

In addition to the AMSAT-NA Fox cubesat launch opportunity announcements several other satellites with amateur radio transponders are expected to launch during 2013.

A 2013 Yasny Dnepr Launch should have:

- AMSAT-UK FUNcube-1 435/145 MHz 500mW PEP linear transponder and 1200 bps BPSK beacon for educational outreach for a planned 600-700km orbit.
- Delfi n3xT 435/145 MHz linear transponder
- Triton-1 435/145 MHz single channel FM to DSB transponder.
- Triton-2 435/2408 MHz FM transponder + 435/145 MHz FM to DSB transponder
- CPUT ZACube-1 435/145 MHz FM transponder.

May 2013 TURKSAT-3USAT linear transponder aboard China's Chang Zheng-2D rocket.

- Uplink center frequency 145.965 MHz (145.940-145.990 MHz bandwidth). Receive sensitivity -120 dBm.
- Downlink center frequency 435.225 MHz (435.200-435.250 MHz bandwidth). Output power 30 dBm (1W).
- CW beacon on 437.225 MHz.

June 2013 Ukube-1 with AMSAT-UK FUNcube boards to provide an amateur radio 435/145 MHz linear transponder and a 1200 bps BPSK beacon for educational outreach.



Bob DeVarney, W1ICW

For Thomas Edison, persistence and dogged determination were essential character traits. Urban legend has it that he tried no less than 10,000 different possibilities for the electric light filament before settling on the one that ultimately worked. For the budding Moonbounce operator, the same character traits will be most helpful. Allow me to explain.

Unless you have a much larger Ham radio budget than most of us, you will probably have started with a relatively small antenna system, or may even be trying with your Oscar 10/13/40-class antenna system and existing mast mount preamp. This is the route I took for my first 10 or so EME QSOs. Patience will be a virtue with such a small antenna system, both for you, and for the operator on the other end. Understand that while contacts can be made with 100 watts and a single yagi, they will be few, challenging, and far between, and with only the very largest of stations.

Even with my current array of four 7-element yagis and a kilowatt amplifier, I am considered to be a small EME station. But small can be beautiful. In the short time (2-1/2 years) I have been on the moon, I've only encountered a very tiny handful of stations that I have been unable to work. But recent QSOs with several stations I had considered unworkable have really opened my eyes.

Recently, I worked OK1TEH, Matej, who runs a single yagi station in the Czech Republic. We had been trying to work for some six months, and usually I was not able to see him but he could see me fine. I had all but given up because he was a single yagi station, and almost considered him too small for me to work. But we did not give up, and lo and behold, on November 21st we worked. For a short period of about 15 minutes, he appeared, almost magically, up out of the noise, and we worked. Not more than a day or two later, I worked Ric, CX2SC in Uruguay. He runs a relatively small station like me, but what makes him challenging is he is in the southern hemisphere, and due to my high Northern latitude (roughly 45 degrees) the polarity rotation is usually not in my favor for South America or African stations. But sure enough, on November 23rd, we worked, and it was a similar QSO where he just came up out of the noise, we worked, and then he was gone. But the final QSO that convinced me was working LU1CGB, Adrian, in Buenos Aires, again for only a short period visible, but we worked.

The point I am making here is not to give up or get frustrated. To me, working EME with a small station is akin to working HF with a QRP rig. I have a nice tribander and 100-watt HF rig, but found the "shooting fish in a barrel" type of QSOs to be unsatisfying, and I missed the challenge of my Novice days, when working stations, ANY stations, with my Heathkit DX-60 and Knight receiver with a longwire was both challenging and exciting. I got bitten by the QRP bug after building an Elecraft K2 in 2001, and found the challenge of chasing DX with 3 watts and a longwire antenna at my old condo location was very exciting. It was certainly neither ho, nor hum.

I am still using that very same Elecraft K2, albeit with a companion Elecraft transverter to make my EME QSOs now. I run about 3 watts out of the Elecraft XV144 transverter to drive a homebrew solid state kilowatt amplifier, and, even with this high power level, due to my antenna array, I am considered to be a "small gun." If I upgraded to four M2 XP20s, or any similar antenna with switchable polarity, the polarity rotation issue would go away, because I could switch polarities on tx and rx. But I find the fact that I am limited to a single polarity to be part of the challenge, and therefore fun.

The moral of the story here is that with a small station, you will have to put in more time on the air, which isn't necessarily a bad thing. If you are on, every night, day in, and day out, you will eventually work every station you are physically possible of working... it just takes time. The same Faraday rotation that makes strong stations go away in a matter of mere minutes can also swing in your favor. Since the period of the rotation effects on 2 meters is approximately 30 minutes, theoretically you only have to wait half an hour or so before you can work a station. But that doesn't always happen

so nicely.

On 1296 (23 cms) the Faraday rotation period can be an entire day, which is why on that band and above, they typically use circular polarity to cancel out the effect.

There are some really good explanations of the Faraday rotation and spatial polarity effects, but few are better than N1BUG's explanation here:

<http://www.glogy.com/www.n1bug.net/operate/emepol-1.html>

There is also a handy spatial calculator built into the MoonSked program which can help you calculate the best times to work a station, and build your skeds around them.

The best times to operate in March will from the 9th through the 29th, and the worst time will be from the 2nd through the 8th. For April, the best days will be from the 4th through the 27th, while the worst times will be from the end of March through April 3rd, and again at the end of the month beginning on the 28th.

There are several DXpeditions in April, including 5W0M to Samoa from the 4th through the 18th, and PE1L, PA3CE, and PE9DX are planning a trip to Ghana on or around April 12th to April 27th.

Lastly, don't forget the EME net on 14.345 on Saturdays and Sundays from 1500 UTC, with Steve N4PZ as net control. It's listed as "winters in the Northern Hemisphere", but may be still running in March and April.

That's about it for this time. As always, feel free to email me with comments or questions.

VY 73 de Bob, W1ICW
w1icw at myfairpoint dot net



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AMSAT-NA Board of Directors Nominations Due June 15

It is time to submit nominations for the upcoming open seats on the AMSAT-NA Board of Directors. A nomination requires either one Member Society or five current individual members in good standing to nominate an AMSAT NA member for the position. Four director's terms expire this year:

- Barry Baines, WD4ASW
- Alan Biddle, WA4SCA
- Drew Glasbrenner, KO4MA
- Tony Monteiro, AA2TX

In addition to traditional submissions of written nominations, which remains unchanged and is the preferred method, nominations may be made by electronic means. These include e-mail, FAX, or electronic image of a petition. Electronic petitions should be sent to MARTHA@AMSAT.ORG or faxed to 301-608-3410.

Written nominations, consisting of names, calls and individual signatures should be mailed to: AMSAT-NA, 850 Sligo Ave #600, Silver Spring, MD, 20910.

No matter what means is used, petitions MUST arrive no later than June 15, 2013 at the AMSAT-NA office. If the nomination is a traditional written nomination, no other action is required. If it is other than this, i.e. electronic, a verifying traditional written petition MUST be received at the AMSAT-NA office at the above address within 7 days following the close of nominations on June 15, 2013.

ELECTRONIC SUBMISSIONS WITHOUT THIS SECOND, WRITTEN VERIFICATION ARE NOT VALID UNDER THE EXISTING AMSAT-NA BYLAWS.



In the AMSAT Store ...

<http://store.amsat.org/catalog>

2012 AMSAT Fox Tee shirt. Sand colored tee with Fox logo and CubeSat image across the front.

AMSAT is the North American distributor of **SatPC32**, a tracking program designed for ham satellite applications. For Windows 95, 98, NT, ME, 2000, XP, Vista, Windows 7.

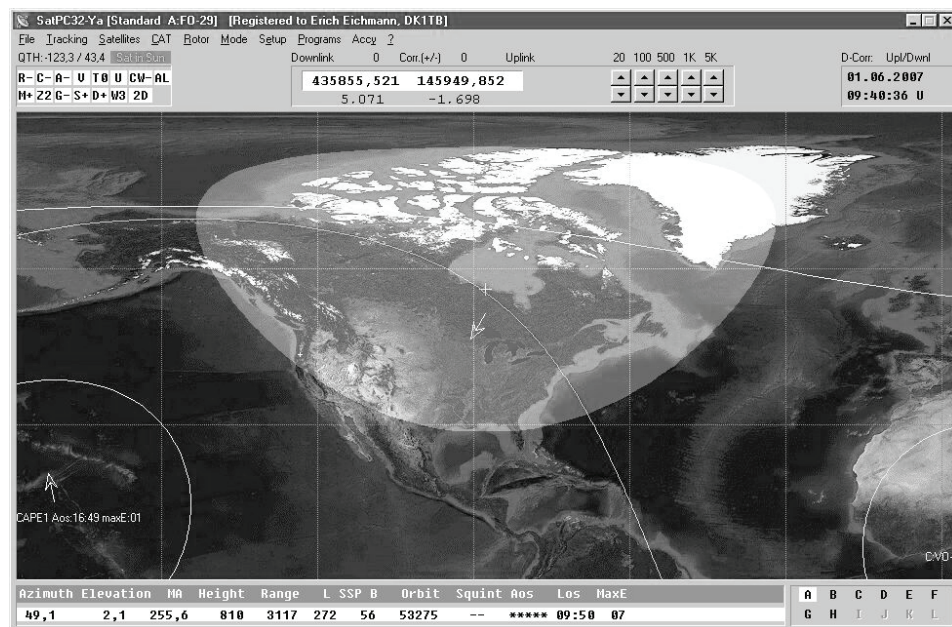
Version 12.8b is compatible with Windows 7 and features enhanced support for tuning multiple radios.

Version 12.8b features:

- SatPC32, SatPC32ISS, Wisat32 and SuM now support rotor control of the M2 RC-2800 rotor system.
- The CAT control functions of SatPC32, SatPC32ISS and Wisat32 have been expanded. The programs now provide CAT control of the new Icom transceiver IC-9100.
- The main windows of SatPC32 and SatPC32ISS have been slightly changed to make them clearer. With window size W3 the world map can be stretched (only SatPC32).
- The accuracy of the rotor positions can now be adjusted for the particular rotor controller. SatPC32 therefore can output the rotor positions with 0, 1 or 2 decimals. Corrections of the antenna positions can automatically be saved. In previous versions that had to be done manually.
- The tool 'DataBackup' has been added. The tool allows users to save the SatPC32 program data via mouse click and to restore them if necessary. After the program has been configured for the user's equipment the settings should be saved with 'DataBackup'. If problems occur later, the program can easily restore the working configuration.
- The rotor interfaces IF-100, FODTrack, RifPC and KCT require the kernel driver IOPort.SYS to be installed. Since it is a 32-bit driver it will not work on 64-bit Windows systems. On such systems the driver can cause error messages. To prevent such messages the driver can now optionally be deactivated.
- SuM now outputs a DDE string with azimuth and elevation, that can be evaluated by client programs. Some demo files show how to program and configure the client.

Minimum Donation is \$45 for AMSAT members, \$50 for non-members, on CD-ROM. A demo version may be downloaded from <http://www.dk1tb.de/indexeng.htm>. A registration password for the demo version may be obtained for a minimum donation of \$40 for members and \$45 for non-members. Order by calling 1-888-322-6728.

The author DK1TB donated SatPC32 to AMSAT. All proceeds support AMSAT.



Patrick Stoddard, WD9EWK/VA7EWK
wd9ewk@amsat.org

Ever since I started working the amateur satellites, I enjoyed the thought of operating away from home. My first opportunities for this were in 2006, on trips to Dayton and the AMSAT Symposium in San Francisco. Starting in 2007, I took road trips to different locations (and different grids) around Arizona. During the summers of 2008 and 2009, I took road trips around northern Arizona and neighboring states. As I went to these places, I operated satellites from wherever I happened to be. Many of the grids I stopped in are rarely heard on the satellites. For my 2010 summer vacation, I decided to do another road trip, but not in the southwestern USA. I decided that the road trip would be around British Columbia in Canada, on the Lower Mainland as well as nearby Vancouver Island. I also planned to work satellites in SSB as well as FM on this trip; I only worked FM on the 2008 and 2009 road trips. I drove over 3000km (almost 1900 miles), operated from 9 different grid locators including one grid boundary and an international boundary, and logged almost 400 satellite QSOs. AO-7 had started a period of constant illumination, meaning I could use that satellite every other day in mode B. HO-68 was in FM for the week of 4-10 July. This turned out to be a great satellite for this trip, giving more opportunities for FM satellite QSOs with VA7EWK from several different grid locators.

For hams from the USA and many other countries, Canada is a simple place to operate from. Canada recognizes US amateur licenses and participates in the CEPT and IARP licensing schemes. Hams from other countries not covered by CEPT or IARP can request a temporary permit from Industry Canada. After making many trips to Vancouver in the late 1990s and early 2000s, I wrote the exams to obtain a Canadian amateur certificate in 2002 and received my VA7EWK call sign. More information about the Canadian amateur service is available online from the licensing authority, Industry Canada¹. Additional information about amateur radio in Canada is available from the national organization, Radio Amateurs of Canada².

I booked a round-trip ticket for my flights between Phoenix and Vancouver, leaving Phoenix on 3 July 2010 and returning on 11 July. This would give me a full week in Canada, plus parts of two other days. I planned to split my trip into 2 parts – the first 4 full days on Vancouver Island, then

the remainder of the trip in and around Vancouver. This turned out to be a perfect plan. I would have time to see the sights, take pictures, and work the radios. I brought a few radios on the trip: for FM, an Icom IC-T7H 2m/70cm HT and an Icom IC-2820H 2m/70cm mobile radio; for SSB, a pair of Yaesu FT-817NDs. Antennas used on this trip were an Elk Antennas handheld 2m/70cm log periodic and a Smiley Antenna 2m/70cm telescoping whip for the HT. This is my normal portable satellite station, so I was confident I could have success operating from wherever I happened to stop in Canada. The radios and accessories that were not banned from carry-on baggage went in a large laptop bag. The log periodic antenna and everything else for my radios went in a large duffel bag I used for my clothes, which was checked in at the ticket counter for the flights.

After arriving at Vancouver airport and clearing Customs on Saturday (3 July) afternoon, I rented a car – a Chrysler PT Cruiser. The PT Cruiser was larger than I needed, but it allowed me extra space to store radio equipment and quickly assemble it to work the satellites when on the road. I could leave my log periodic sitting fully assembled in the back of the car. I spent a couple of hours in and around Vancouver for lunch and some time to ensure all of my radio equipment survived the flight before taking a ferry over to Vancouver Island. I also decided to try out the radios on some satellite passes in the late afternoon from the Vancouver area, in grid CN89.

I found 3 passes in the span of an hour starting around 1745 local time (0045 UTC) – AO-51, FO-29, then AO-7 in mode B. I worked all 3, logging 13 QSOs on AO-51, 7 on AO-7, then 4 more on FO-29. After those passes, I packed the radios up for the drive across Vancouver to Horseshoe Bay, the ferry terminal I would use to get to Nanaimo on Vancouver Island. The ferry ride was 90 minutes, followed by a 90-minute drive from Nanaimo up Highway 19 to the city of Campbell River, at the CN79/CO70 grid boundary (50° North) where I would spend the next 3 nights. I arrived at the motel just before 0100 local time (0800 UTC), and quickly went to bed.

While on Vancouver Island for 4 days, I operated from 5 different grids. I started out on Sunday (4 July) at a spot on the 50th parallel near my hotel in Campbell River, on the CN79/CO70 grid boundary. On Monday

(5 July), I drove to Port Hardy on the north end of the island in grid CO60. I had tried to find a spot on the northwest corner of the island in grid CO50, but the mountains in that area made that a bad option, so I spent most of the day along the waterfront in Port Hardy working many passes. After checking out of my motel in Campbell River on Tuesday (6 July) morning and working one more AO-7 pass at the CN79/CO70 grid boundary, I drove west toward the Pacific side of Vancouver Island. With one stop at Port Alberni, about 1/3 of the way to the island's west coast where I worked an HO-68 pass, I made it to Ucluelet on the coast in grid CN78 just in time for an AO-27 pass at 1255 local time (1955 UTC). I worked many passes in FM and SSB until the early evening, and drove back to Port Alberni for the night. On Wednesday (7 July), I drove down to Victoria (grid CN88) on the south end of the island. I operated from two locations outside Victoria during the morning, and more passes around midday from the Mile 0 monument – the western end of the Trans-Canada Highway, where I could look across the water to the south and see Washington state.

After the operating and walking around the center of Victoria, I drove north to the Swartz Bay ferry terminal and the *M/V Spirit of Vancouver Island* for a 95-minute ride to the Tsawwassen ferry terminal south of Vancouver. About halfway through the ride, around 2245 UTC, there was an AO-27 pass. I decided to try working this pass with my IC-T7H HT and a telescoping whip, instead of using my log periodic and attracting too much attention from the ferry crew. I only heard the satellite for about 3 minutes, and logged 2 QSOs while sailing through grid CN88hu and some small islands near Vancouver Island. Thanks to Jeff K7WIN (now K2AK) and Sawson KG6NUB for hearing me and being patient as I asked for repeats to complete these QSOs. The 7-minute timer expired as I attempted to log a QSO with Dale KL7XJ. These were my first QSOs from a ship, and I gained an appreciation for what satellite operators like Allen N5AFV, Andy W5ACM, and others have done on many cruises and ships.

After the ferry ride, I drove to my motel in Vancouver. The thermometer in the PT Cruiser showed the afternoon temperature in Vancouver at 36°C (96°F). This was not as warm as I would have experienced back in Phoenix, but was warm with the humidity that I don't normally see back home. I



decided to take a break from the radio for the evening. I had dinner at a nearby restaurant, then drove across to Burnaby and visited with John VE7JRX – a long-time Vancouver satellite operator.

I had some plans already made for Thursday (8 July) in and around Vancouver. I wanted to do some sightseeing south of the city, including the Peace Arch Park³ at the Canada/USA border. I was also planning to attend a meeting of the North Shore Amateur Radio Club⁴ in North Vancouver in the evening. I decided to do some operating on a few passes from Surrey, a suburb south of Vancouver, in the morning and early afternoon. I found a parking lot near Highway 99, the freeway from Vancouver to the border and the northern end of Interstate 5, and worked 4 passes. On 2 HO-68 passes, an AO-7 pass, and an AO-27 pass, I logged 19 QSOs before moving on to White Rock and then Peace Arch Park.

Before this trip, I thought about the possibility of operating from the Canada/USA border. Standing on the border is generally not permitted, but it is encouraged at Peace Arch Park. This park is actually two parks - a British Columbia provincial park and a Washington state park, divided by the international border. Through the middle of the park are border markers to the west and east of the arch. Within the park, it is legal to cross the border without any border formalities, provided you leave from the side of the park you entered. I took my HT, log periodic, and a camera from my car and walked to the arch. I took some pictures, and then identified the spot I would operate from – next to one of the border markers west of the arch and the southbound lanes of the highway running through the park (British Columbia Highway 99 to the north of the arch, and Interstate 5 to the south).

Due to the technology of the day when the border markers were established, none of them at Peace Arch Park are situated on 49° North, which is defined as the border by treaty. The 49° North line was actually at the US Customs building on the south end of the park. In the park, the border is just north of the CN88/CN89 grid boundary. I operated from grid CN89oa at that border marker, standing with one foot on each side of the border, and identifying my station as VA7EWK and WD9EWK. I worked two passes from here – a west-coast AO-27 pass around 2217 UTC, followed by an eastern AO-51 pass at 2307 UTC. I logged 6 QSOs on AO-27, and 10 QSOs on AO-51. I printed special QSL cards for the QSOs made at this location; a VA7EWK QSL card on one side,



The VA7EWK satellite mobile station in Port Hardy, CO60



Close up of the VA7EWK satellite setup



The 50th parallel monument north of the CN79 - CO70 grid boundary

and a WD9EWK QSL card on the other side. Both sides of the card had the same QSO information, and identifying the location at each side of the border marker (Surrey, British Columbia; Blaine, Washington, in Whatcom County).

Friday (9 July) morning started early. I wanted to drive up to Whistler, the ski resort about 2 hours north of Vancouver, where I hoped to operate from grid CO80. Once again, mountains and trees complicated my plans for satellite operating. I drove near the heliport north of Whistler Village at grid CO80ne for an HO-68 pass at 1643 UTC, and worked 8 stations in 5 minutes. This was not a great place to work satellites, as I only could see 1/3 of the HO-68 pass. I drove around more, scouting out other locations to work from, but missing other passes I could have worked. I grabbed some lunch, and took a long clockwise drive around the southwestern corner of British Columbia, something I had not planned on doing before this trip. I was able to work from two other locations in CO80 on later AO-27 passes – one overlooking Alta Lake west of Whistler Village in grid CO80me (6 QSOs in the 3 minutes I could hear AO-27), and the other northeast of Pemberton along Highway 99 in grid CO80tj (9 QSOs). I kept driving up the highway, and then started working my way south back toward Vancouver on Highway 12 and the Trans-Canada Highway. I stopped in two other grids for passes in the late afternoon.

I stopped along Highway 12 north of the Trans-Canada Highway and the town of Lytton for one AO-51 pass just after midnight UTC in grid CO90eg. This would be my only operating from grid CO90, and it was a good pass. Twenty stations went in the log here, from all over the continental USA and Alaska. After this pass, I drove about 30 minutes to a spot just into grid CN99 along the Trans-Canada Highway. I worked 3 passes from grid CN99gx in the town of Boothroyd – AO-7, FO-29, and AO-51 – in the span of an hour. Twelve more QSOs went in the log. I stopped at another point along the Trans-Canada Highway north of the town of Hope for an FO-29 pass around 0300 UTC, but logged no QSOs there. After a dinner break in Hope, I drove back to Vancouver for the night on the Trans-Canada Highway and planned a return to Whistler. I covered over 670km (416 miles) in this loop around British Columbia, along with operating from 3 different grids.

Saturday (10 July) morning came, and I wanted to make another try at operating from Whistler. The spot I stopped at near Alta

Lake was the best spot I saw near Whistler Village, and went there for an SO-50 pass followed by an HO-68 pass around 1615 UTC. I logged 5 QSOs on SO-50, then 13 more on HO-68. This was a good spot, but I wanted a better operating location. I saw one, and decided to try for it. I packed my HT, log periodic, GPS, and a camera in a small duffel bag, then took the gondola to the top of Whistler Mountain. In the summertime, one can walk around the mountaintop, or use the ski runs for jogging and mountain bike riding. I was interested in sightseeing, plus riding the PEAK-2-PEAK gondola between the tops of the two main ski mountains here, Whistler Mountain and Blackcomb Mountain.

Before seeing the top of Blackcomb Mountain, I wanted to find a good spot on Whistler Mountain to operate from. I used an observation deck on the Roundhouse building at Whistler Mountain, at 1850m (6069 feet) elevation in grid CO80ma, and had no problems from here. I worked an SO-50 pass at 1755 UTC covering the Pacific coast, logging 5 QSOs. The next SO-50 pass at 1935 UTC yielded one QSO with Dale KL7XJ in Alaska, and then an AO-27 pass started just after that. I could hear the last 3 minutes of the 7-minute pass, but I could not get a signal through. I had been exchanging e-mails, text messages, and phone calls with Drew KO4MA, all in the hopes of making a QSO with him from grid CO80 while I was in this area. I told Drew I would try to work him first, and then work anyone else I could in the remaining time. I heard Drew call me with less than a minute to go on the AO-27 pass, and then I was able to get through to make a call back to him. We were able to make the QSO with about 10 seconds to spare, and this was my only QSO on the pass.

Before the next AO-27 pass, I took the PEAK-2-PEAK gondola over to Blackcomb Mountain, walked around and took pictures, then crossed back to Whistler Mountain in time for the AO-27 pass at 2120 UTC. I logged 6 QSOs on this pass, which was the final pass I worked for this trip. After taking pictures of the different 2010 Winter Olympics venues in and around Whistler, I returned to my hotel in Vancouver for my final night in Canada.

On Sunday (11 July), I did some sightseeing around downtown Vancouver, including Stanley Park, before going to Vancouver airport. When I returned the car to the rental-car agency at the airport, the receipt showed that I traveled 3024km (1879 miles). I checked in at the ticket counter, went through the airport security and US

Customs checkpoints, and then flew home to wrap up this trip.

For this trip, I made 393 QSOs from 9 different grids – 5 on Vancouver Island (CN78, CN79, CN88, CO60, and CO70), and 4 on the Lower Mainland (CN89, CN99, CO80, and CO90). Here is a breakdown by mode and satellite, and by grid:

QSOs on FM Satellites	
AO-27	97
AO-51	112
HO-68	74
SO-50	48
84.2% of all QSOs - Total 331	

QSOs on SSB/CW Satellites	
AO-7	SSB - 30; CW - 2
FO-29	SSB - 23
VO-52	SSB - 7
SO-50	48
15.8% of all QSOs - Total 62	

QSOs by Grid	
CN78 - Ucluelet on Vancouver Island	56
CN79 - Port Alberni on Vancouver Island	21
CN79/CO70 - Campbell River on Vancouver Island	85
CN88 - Around Victoria and the Ferry	25
CN89 - Around Vancouver, including Canadian/USA Border	59
CN99 - North of Lytton, north of Vancouver	12
CO60 - Port Hardy on Vancouver Island	61
CO80 - Around Whistler, B.C.	54
CO90 - Boothroyd, northeast of Vancouver	20

Despite being so far north and not having all of the 7-minute repeater time on AO-27 passes, that satellite worked well for me during this week. Having HO-68 in FM for this week was a nice bonus. I was impressed with how well I was able to work AO-7 and FO-29, and those larger footprints helped in getting other operators some of these rarely-heard grids. Since the VO-52 passes were very close to the HO-68 passes, I ended up only working one VO-52 pass on this trip. I enjoy working VO-52, but HO-68's higher orbit and mode for this week (FM) made that the obvious choice for passes in the mid-morning hours.



Thanks to John K8YSE⁵ for his assistance during this trip. He would be available via phone and e-mail to answer questions or look up information while I was traveling, and posted some messages to the AMSAT-BB list when I was not able to do so myself. John has done his share of road trips working satellites, along with other trips working HF from locations around the world. He has a wealth of information I could lean on. And a thank-you to all the satellite operators that made QSOs with VA7EWK during this trip.

73!

Notes:

1. Industry Canada: <http://strategis.ic.gc.ca/radioamateur.e>
2. Radio Amateurs of Canada: <http://www.rac.ca/>
3. Peace Arch Park: <http://www.peacearchpark.org/>
4. North Shore Amateur Radio Club (North Vancouver, BC): <http://www.nsarc.ca/>
5. John K8YSE: <http://www.papays.com/sat/>



The web development team, working on the recovery of the AMSAT-NA web at <http://www.amsat.org>, reports the site is becoming active with testing of the system. As testing proceeds visitors to AMSAT's site will begin to see restoration of prior functionality and introduction of new features where appropriate.

AMSAT VP User Services Gould Smith, WA4SXM said, "Our web team is making good progress in the restoration of popular features our users counted on in the past. This also gives us an opportunity to review some of the older content to prioritize in what order the system is brought back up."

The roll-out of the Fox Project web pages can be accessed with a click on the menu bar at the top of the home page.



(above) Monument demarking the Canadian/USA border

(left) The Peace Arch on the Canadian/USA border



Satellite gear on the observation deck at Whistler, B.C. in CO80



Downtown Vancouver from Stanley Park



Domenico Marini, I8CVS, domenico.i8cvs@tin.it

The low-noise cavity preamplifier discussed in this article was designed by DL9KR and was described in an issue of K2UYH's *432 and Above EME News*¹.

A copy of this preamplifier was built by I5TDJ and it was the winner during the First Symposium in Orvieto². It had a noise figure (NF) of 0.5 dB and a gain (G) of 20 dB.

I built two prototypes of this preamplifier for use in 432 MHz EME and 435 MHz for satellites with similar results. This design was chosen because of its selectivity and its 1 dB compression point as well the input third-order intercept point (IP3) being very high.

Circuit Description

The original preamplifier shown in Figure 1 and Figure 2 can use either the 2SK571 GaAsFET from NEC or its professional version, the NE 72089A. For top performance, however, it is best to use either a more costly 2SK406 or a NE 71083. By the way, the well-known family of MGF-1302, MGF-1402, or MGF-1502 GaAsFETs works equally well with a very small difference in NF and G.

This preamplifier was also tested with the ATF-1036. It works equally well provided the gate polarization (i. e. the resistor between source and ground shown in the Figure 1) is 47 Ω . Both source bypass capacitors are leadless 470 or 1000 pF round disc ceramic while the drain is supplied with 3.9 volts.

In any case, regardless of which type of the aforementioned active devices is used, it is essential that the source and output capacitors are 470 pF ATC high-Q porcelain square capacitors about 50 or 100 thousands of an inch in size.

As shown in Figure 1, the input circuit with capacitors C1 and C2 and the cavity line L1 are the heart of this cavity preamplifier.

Capacitors C1 and C2 are critical as they are air-variable capacitors with a high Q factor and are available in standard sizes from several manufacturers such as Murata, Airtronic, Johanson, or Microelectronics.

For C1, I used a Microelectronics model MAV01A03 with a capacitance range 0.4 to

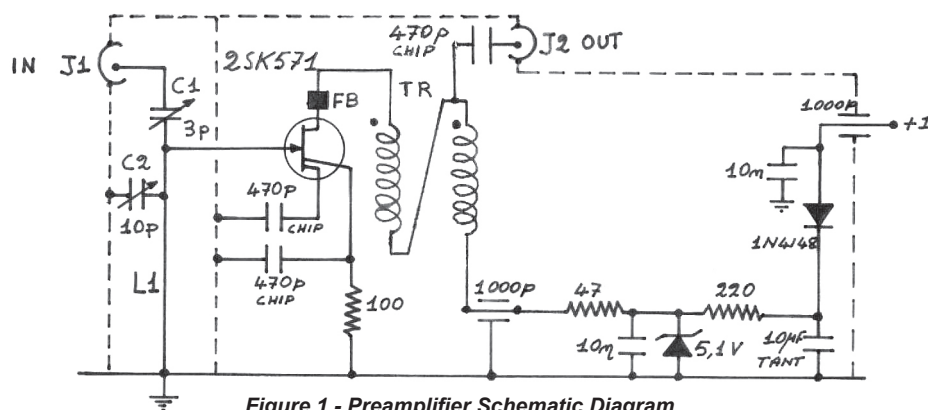


Figure 1 - Preamplifier Schematic Diagram

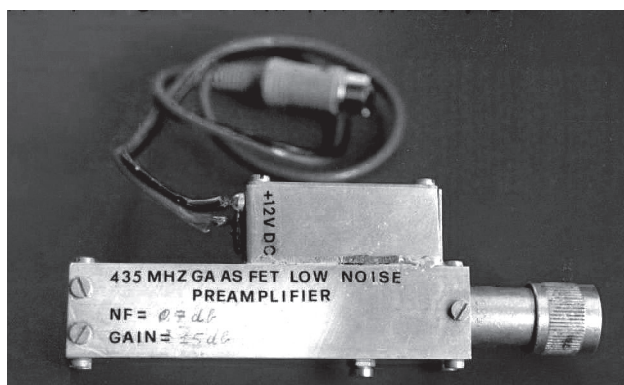


Figure 2 - External View of Assembled Preamplifier

3.5 pF and Q factor > 10,000 at 100 MHz. It has a cylindrical nut and cover cap. For C2, I used a MAV03A10 with a capacitance range 0.8 to 10 pF and Q factor > 5,000 at 100 MHz, but has a hexagonal nut and cover cap.

Both of the air capacitors and the cavity line L1 are connected to the gate of the GaAsFET. The drain is supplied through a bifilar transformer TR with 2 turns for the primary and 5 turns for the secondary. Both transformer coils are wound on a 3 mm binocular ferrite bead (i. e., two holes side to side).

Transformer TR is wound with bifilar wire so be careful when connecting the end of one winding to the beginning of the other winding. The black dot in Figure 1 indicates the beginning of both bifilar windings, which are made using #32 A.W.G. (B&S) enameled wire.

The ferrite bead for TR is not critical provided that the resistance of the ferrite material, as measured with an ohmmeter between the holes, is on the order of 30 k Ω .

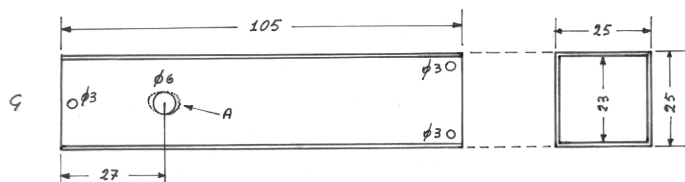
As shown in Figure 1, the output of the preamplifier is taken from the center of

transformer TR through a 470 pF ceramic high-Q chip porcelain ATC capacitor. To improve the stability and prevent auto-oscillations, a small ferrite bead FB is inserted into the drain lead of the GaAsFET. For that bead, I used one made from Fair-Rite No. 43 material, which is especially suitable for this purpose.

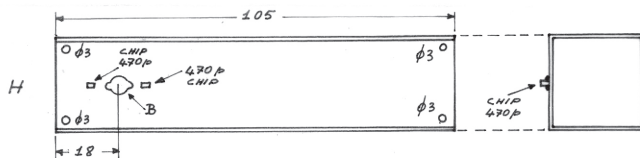
As shown in the Figure 1, the gate polarization is obtained by a voltage drop across a 100 Ω chip resistor while both source leads are bypassed to ground through the two high-Q 470 pF ATC chip porcelain capacitors.

The input N male connector (J1 on Figure 1) is also critical and it must be a type UG21-B/U with Teflon™ insulation and a captivated inner pin. This pin is very important so care must be taken not push on it or pull it towards the capacitor C1 while connecting J1 to the N relay or the antenna female connector.

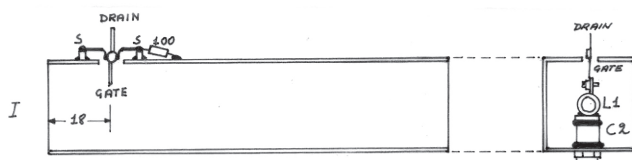
The Q_0 factor of the input cavity, as measured under no load (i. e., without the GaAsFET and all the rest of associated components), was very high and was measured using the following set-up:



Q = BRASS SQUARE TUBE 25x25mm 1mm THICK
A = HOLE ϕ 6mm TO SCREW IN IT THE CAPACITOR C1 = 10PF TRIMMER



B = HOLE DIAMETER ϕ 5mm TO PASS IN IT THE GATE OF 2SK574



LONGITUDINAL SECTION OF THE CAVITY WITH INSTALLATION OF 90AsFET 2SK574, TUNING CAPACITOR C2 AND RESONANT LINE L1

DRAWING SCALE 1:1

CVS-4

Figure 5 - Preamplifier Cavity Details

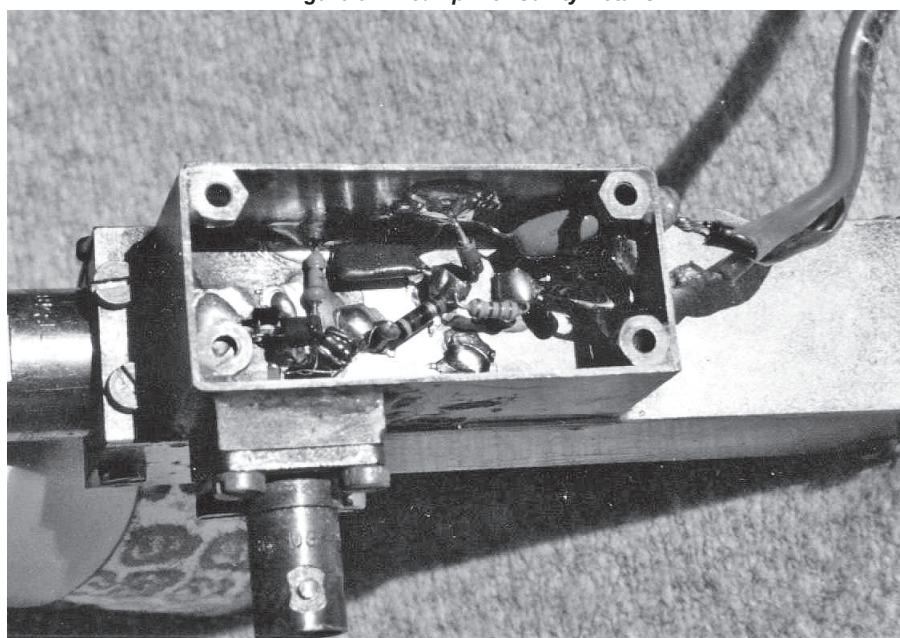


Figure 7 - Internal View of Preamplifier Enclosure

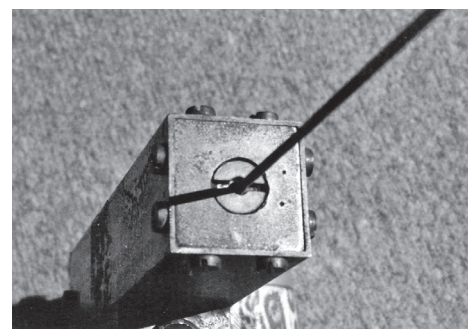


Figure 6 - Tuning Capacitor C1 With Custom-made Screwdriver

plated with silver, particularly inside the cavity's square-section tube (25 mm x 25 mm x 1 mm wall cross-section, shown in Figure 5). No mechanical part should be soldered with tin. Every piece must be tightly pressed into its corresponding component and then fastened into place with screws.

Using silver plating on the mechanical parts plus fastening them together this way makes the electrical resistance between those parts lower than if they were soldered with tin alloy (composition 62% Sn, 36% Pb, and 2% Ag).

Please note that the electrical resistivity of the above alloy is $11 \times 10^{-6} \Omega\text{-cm}$ while for the pure silver, the value is $1.6 \times 10^{-6} \Omega\text{-cm}$.

At 435 MHz, the depth of penetration of the electrical field into a copper conductor is about $3 \mu\text{m}$ so a thin silver coating is enough. The coating, however, should be made by an electrolytic process because coating with chemical products is not suitable for parts used in the outside environment.

In my two prototypes, I used electrolytic copper material for all pieces depicted in Figure 4. This is particularly important for the tubular cavity line L1 which is made from copper tubing with a 6 mm outside diameter and 4 mm inside diameter. All pieces are silver plated.

The most critical part where the metal-to-metal contact must be perfect is the bottom of the cavity at the end of the line L1 at the point where it is fastened to the 17.5 mm x 17.5 mm metal bottom block by the 5 mm countersunk screw shown in Figure 4, view D. At this point, the RF cavity current has the maximum value and, then, the maximum losses.

The tube shown in Figure 5 can also be made from 1 inch x 1 inch square tubing available in North America. That's because the difference between its cross-sectional

dimensions and those for 25 mm x 25 mm square tubing available in Europe are small. So, if the all the remaining dimensions of the mechanical parts shown in the drawings are carefully converted from millimeters into inches, there should be no problems with the mechanical assembly. There also shouldn't be any difficulties in tuning the input circuit to 432 or 435 MHz, even if the selectivity of the input circuit is very sharp.

Mechanical Assembly

When all the mechanical parts are machined and plated with silver, refer to Figure 4, view C. Insert the 23 mm x 23 mm bottom block C into the square tubing, tapping it carefully with a small hammer. Next, fasten the block to the square tubing using eight 3-mm diameter brass screws.

The tapped end of line L1 (shown in Figure 4, view E) should be fastened to the bottom of the 23 mm x 23 mm block (Figure 4, view A) using the 5 mm perforated countersunk screw (Figure 4, view B). The other end of L1 will hold capacitors C1 and C2 and the associated hardware to be connected to the gate of the GaAsFET.

The line L1 is 82 mm long and is tapped at the bottom end with a 5 mm thread. The inside threaded length is 10 mm in order to receive the 5 mm countersunk screw shown in Figure 4, view B.

The input end of L1 has a small stirrup to be used to make contact with the gate lead of the GaAsFET without soldering that lead to L1. This prevents excess heat to the device during assembly. The gate is fastened to L1 using only a small 1 mm screw.

The threaded stator of C1 has a diameter less than the 4 mm inside diameter of L1. C1 is supplied with a small round gold-plated nut. This nut must be soldered concentrically into the input end of L1 with tin. This allows it to be fastened with perfect alignment onto the rotor of C1 as shown in Figure 3.

The central conductor of the connector J1 is lengthened, as shown in Figure 4, view F. A 1 mm diameter x 5 mm deep hole is drilled longitudinally with a lathe and is used to hold the pin of the stator of C1. That pin is fastened in place using a 1 mm screw.

Capacitor C1 is tuned using a custom-made screwdriver. I made one from a 20 cm long rib recovered from an old umbrella. One end was ground to form a very straight shaft 2 mm in diameter, ending with a flat taper to make a blade.

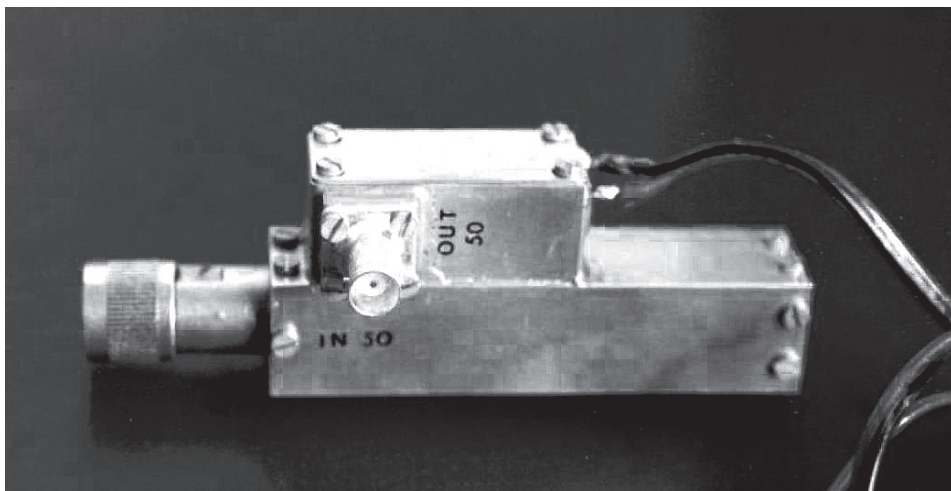


Figure 8 - External View of Assembled Preamplifier

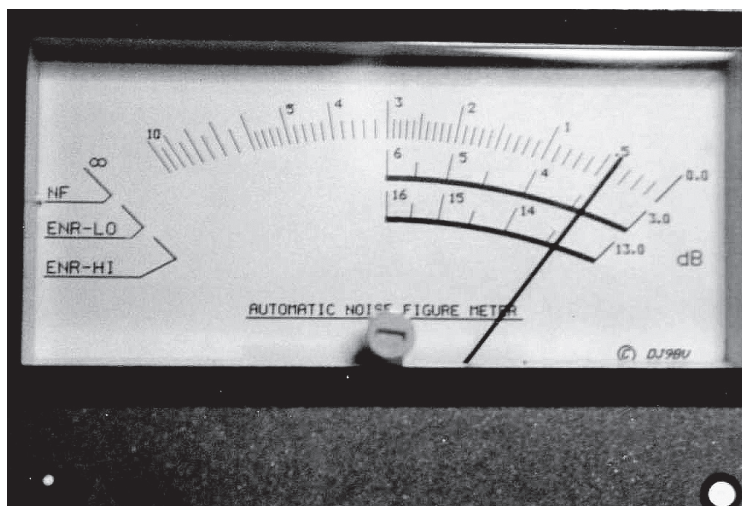


Figure 9 - Homebrewed Noise Figure Meter
(Reading shows a noise figure of 0.4 dB obtained after tuning capacitors C1 and C2 for minimum noise)

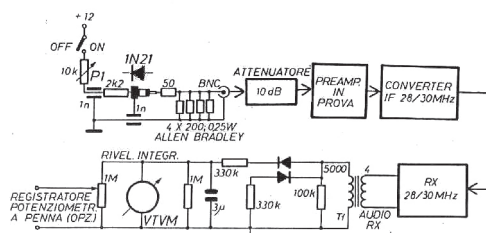


Figure 10 – Drawing CVS-5 – Diode Noise Generator Schematic Diagram
(Attenuatore = attenuator
Preamp in prova = preamplifier under test
Rivel. integr. = detector-integrator
Registratore potenziometr. a penna (opz) = plotter (optional))



As seen in Figure 6, the shaft of this screwdriver is inserted into L1 through the hole of the 5 mm screw (Figure 4, view B). It is long enough to reach the small screw inside the rotor of C1 with the blade fitting into the screw's slot.

Inside line L1, no DC or RF are present and, so, L1 functions like a Faraday cage. The material of the screwdriver does not interfere with the tuning of C1 to obtain the lowest noise figure.

Figure 3 shows capacitor C2 connected to L1. This is done using a copper disk 6 mm in diameter. This disk is hot soldered to L1 using brass at 72 mm from the bottom (i. e., the threaded end) before plating the assembly with silver (see Figure 4, view E). A 1.5 mm hole is then drilled into its center and then tapped. The stator pin of C2, which also has a 1.5 mm thread, is inserted into the hole in the disk.

All components of the Figure 1 such as resistors, capacitors, and the zener diode are enclosed in a small box shown in Figure 7. This box is made from a thin brass sheet and soldered on top of the square tubing of the cavity (see Figure 5) near the GaAsFET. This is done to keep the connection as short as possible while the RF output is taken through a 470 pF ATC porcelain capacitor and a female BNC connector as shown in Figure 8.

First Test of Preamplifier

1. Connect a 50 ohm termination or a good 70 cm antenna to the preamplifier input.
2. Connect the preamplifier output to the RF input of a 70 cm receiver or to the RF input of a 432/28 MHz down-converter followed by a 28 MHz HF receiver. The cable is 50 Ω coaxial cable and the length is not critical.
3. Unsolder one terminal of the 47 Ω resistor from the secondary of transformer TR in Figure 1. Connect that resistor in series with a milliammeter which has, at most, a full-scale range of 50 mA.
4. Connect the preamplifier to a 12 volt DC power supply and power up the rest of set-up while reading the current drawn by the GaAsFET. That current should be around 10 mA.
5. Remove the milliammeter and re-solder the terminal of the 47 Ω resistor back in place. You should be able to hear white noise in the loudspeaker of your receiver.

6. Measure the voltage across the 100 Ω resistor connected between the source of the GaAsFET and ground. That voltage should be around 3 volts.
7. As a first step, adjust capacitors C1 and C2 for the maximum audio noise level. This corresponds to the maximum preamplifier gain but not the minimum noise figure.

Tuning for Lowest Noise Figure

There are several ways to adjust capacitors C1 and C2 for the lowest noise figure. The best method is automatic, using instruments such as a precision automatic noise figure indicator (PANFI) or a Sinadder™. Another method is manual, using an inexpensive home-brewed diode noise generator.

A. Tuning With Automatic Noise Figure Meter

Several noise figure instruments are available from sources such as the surplus market or eBay. The most popular are the analog PANFI models made by Ailtech. It is very important to choose a PANFI model which has a 30 MHz RF input and a noise head.

In this set-up, the output of the preamplifier being tested must be connected to the input of a 70 cm down-converter. The 30 MHz IF output of the down-converter must be connected to the PANFI 30 MHz RF input.

The noise head of the PANFI is connected to the preamplifier input. Alternately tune capacitors C1 and C2 until the minimum noise figure and the maximum gain are indicated by the needle of the analog instrument. This is easy to do because the readings obtained by tuning C1 and C2 individually converge quickly to the minimum noise figure.

In order to determine if the preamplifier is unconditionally stable, the noise head must be disconnected from the preamplifier input and the needle of the PANFI observed for any oscillations.

If the needle does not oscillate, the preamplifier is unconditionally stable but this condition is difficult to obtain when using a GaAsFET. (An example of this state is the difficulty in stabilizing a square painting on a wall held in place by a nail at the bottom of the frame instead on the top.)

If the needle of PANFI is stable only when the 50 Ω noise head connected at the input,

the preamplifier is "conditionally" stable provided that the antenna to be used has an impedance of approximately 50+j0 Ω .

Instead of an Ailtech PANFI, I used a homebrewed unit (shown in Figure 9 and described in Ref. 4) which works very well.

B. Tuning With Sinadder

This type of instrument is used to adjust FM receivers for the best (S+N+D)/(N+D) (i. e., signal + noise + distortion / noise + distortion). If it's connected to the output of a receiver, the preamplifier can be automatically adjusted for the lowest noise figure without having to know the value of either the noise figure or gain in dB.

A Sinadder is relatively inexpensive and it would be suitable for our needs. If, however, neither a PANFI or a Sinadder are not available, one can use a manual procedure for tuning.

C. Tuning Manually With Home-brewed Diode Noise Generator

C.1. Noise Generator Construction

The electric circuit diagram of the diode noise generator is shown in Figure 10. It is comprised of an SPST switch (for Noise OFF and Noise ON), a 10 k Ω potentiometer P1 (use one with a shaft long enough to extend through the enclosure wall), a 1N21 or similar microwave diode, two feed-through 1 nF capacitors, one 2k2 ¼ watt resistor, one 50 Ω non-inductive carbon resistor, and four 200 Ω non-inductive carbon resistors (all from Allen-Bradley). Spirally-wound carbon resistors which are inductive should not be used.

All components should be installed in a small weldable tin box with a female BNC Teflon™ insulated output connector. The four 200 Ω resistors must be mounted and quickly soldered with tin in a star arrangement. The resistors are 90° around the flange of the BNC connector and are oriented so that each resistor is pointed radially outwards. One end is soldered to the central connector and the other to the flange. To reduce the inductance, cut the shortest leads as possible. (Remember the rule: "If you can remove the component and use it again, the leads are too long.")

Please note that in order to generate noise, the diode must be reverse-biased (i. e., connected with the cathode at +12 volts).

Microwave diode types 1N21 or 1N23 should



be soldered with tin because, otherwise, the heat will destroy the junction. The tip of the diode must be inserted into a brass pin recovered from an octal socket for electron tubes. The cylindrical side of the diode can be fastened in place using the brass spring contact of a small fuse holder used for printed circuit boards.

When the 10 k Ω potentiometer is turned all the way down, the noise generated is maximum and vice-versa. The noise generated by this circuit can be measured with a spectrum analyzer such as an HP8555A and is usable up to 5 GHz.

As shown in Figure 10, the output of the noise generator must be connected to a fixed 10dB attenuator. This is because the return loss of the input of a GaAsFET preamplifier is very small (on the order of only 2 dB or less) so that the input VSWR is very high (about 9:1). However, while tuning C1 and C2 for the minimum noise figure, the VSWR must be reduced. Including the aforementioned 10 dB attenuator will likely increase the return loss to more than 20 dB (i. e., 10 dB for the incident noise plus 10 dB for the reflected noise).

If a 10 dB fixed attenuator is not available, it can be built using two 27 Ω and one 36 Ω Allen-Bradley non-inductive carbon resistors connected in a T configuration and built into a small metal box with two BNC connectors.

As shown in Figure 10, the output of the attenuator must be connected to the input of a 70 cm down-converter with an IF from 28-30 MHz. The output of the down-converter must be connected to the input of an HF receiver tuned to about the middle of the 28 MHz band.

The loudspeaker audio output of the HF receiver should be connected to a leftover junk box output transformer of the type used in older radios with the audio final tube similar to a 6V6 according to Figure 10.

The secondary of this transformer T1 has an impedance on the order of 4 Ω and must be connected to the HF receiver loudspeaker output. To increase the voltage, the primary of T1 (which has an impedance on the order of 5 k Ω) must be connected to the rest of circuit shown in drawing Figure 10. The rectified voltage is measured with a high-impedance 5 volt full-scale DC voltmeter.

C.2. Tuning Procedure

Connect a 12 volt power supply, the noise generator, the preamplifier, the down-converter, and the HF receiver as shown in Figure 10. Temporarily connect a headphone to the receiver and turn the noise generator potentiometer P1 to the minimum resistance. If everything is all right, the noise into the headphone must change significantly while turning P1.

We can now tune C1 and C2 for the lowest noise figure following the procedure listed below.

1. Switch off the AGC of your HF receiver.
2. Switch the HF receiver mode to SSB or CW, which works linearly using a product detector.
3. Reduce the HF receiver RF gain control to minimum (i. e., completely counterclockwise).
4. Set the HF receiver audio gain control to maximum (completely clockwise).
5. Connect the high-impedance 5 volt (full-scale) DC voltmeter as shown in Figure 10.
6. Set the noise generator SPST to OFF and slowly turn the RF gain knob of the HF receiver until you hear noise. Adjust the RF gain until you read a voltage of 1 volt on the voltmeter (call this voltage V2).
7. Set the noise generator SPST to ON and decrease the resistance of P1. Record the resulting voltage shown on the voltmeter (preferably around 5 volts). This new voltage is V1.
8. Switching the SPST ON and OFF, tune C1 and C2. Try to get the greatest value of the ratio V1/V2, though this could require some time and several adjustments to accomplish it. This value corresponds to the condition of minimum noise figure of the preamplifier. At the end of this process, the results from tuning C1 and C2 will converge to the maximum ratio V1/V2.

In other words, by tuning only C1 and C2 while switching the noise generator SPST on and off, and without adjusting P1 or any setting of the HF receiver, the minimum noise figure can be obtained, which corresponds to the maximum swing of the voltmeter.

At the end of the tuning process, the value of the noise figure is unknown because the diode noise generator is not calibrated in excess noise ratio (ENR). However, the maximum possible performance in sensitivity and its associated gain has been reached for the preamplifier.

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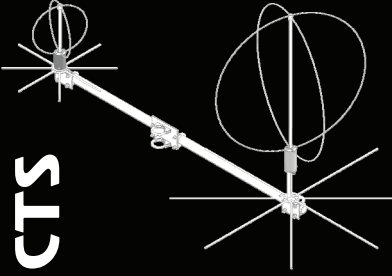
Washington State Area Coordinator, Bob Johnson, W7LRD setup the AMSAT Table at the 2013 Mike & Key ARC Electronics Show on March 9 in Puyallup, WA. Bob ran two laptops with two monitors; one with Satpc32 running the other with a slide show of pictures of his antennas interspersed with pictures of combat flight ops from the USS Ranger. Bob reports he got a couple of new members and a renewal as well as many of the curious.



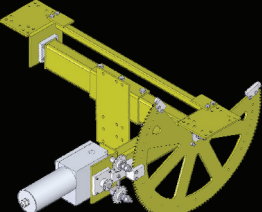
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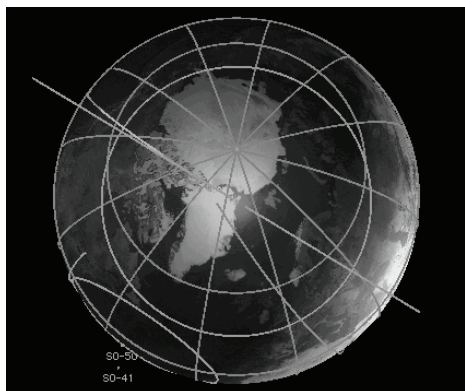
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Apogee View - continued from page 4 ...

views as non-amateur satellites. AMSAT-NA is working with the ARRL to investigate long-term solutions to this situation while also addressing the short-term need for satellites already in the pipeline nearing launch.

AMSAT-NA recognizes the significant positive impact that the university CubeSat programs have provided to the amateur radio satellite community, including:

- Affording launch opportunities as NASA and other government policies encourage development of university satellite programs
- Encouraging students and staff to embrace amateur radio through obtaining amateur radio licenses and establishing amateur radio ground stations
- Providing the potential for more amateur radio communications satellites as the Fox-1 design is made operational, allowing both experimental payloads and amateur radio operations to be supported through a robust and dependable RF design

AMSAT-NA is committed to continue working with the FCC, IARU and ARRL to develop plans and processes that will address the needs and concerns of the small satellite community both short and long term.

AMSAT Web Site

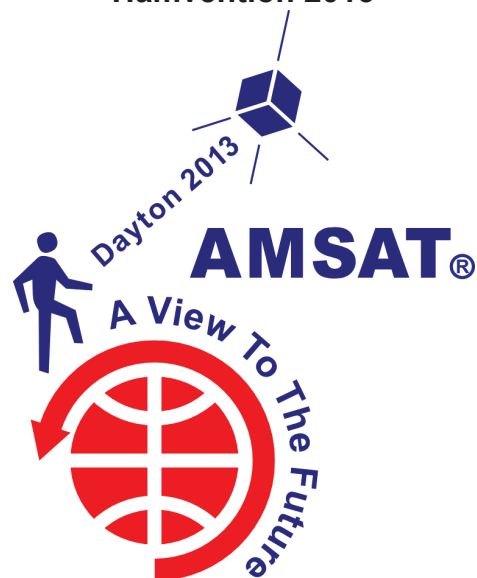
We're fortunate that a team of dedicated volunteers were able to get our website up and running earlier this year following a "hacking" incident. Key features were resurrected on a new platform and users have access to a variety of resources, such as the mail archives, the AMSAT Store, and AMSAT News Service materials. However, much more additional work needs to be accomplished in order to provide services that have not been available since the takedown of the original AMSAT website plus the current site doesn't have an AMSAT "feel" to the pages. Some additional graphics work is needed to have the new website fully reflect an AMSAT identity, or AMSAT "branding".

We recognize that there is a tradeoff between volunteers being used versus paying a firm to do website design. Volunteers are "cheap" but the deliverables are often deferred because of other priorities that the volunteer must deal with or it can be a challenge to find volunteers with both the skills and the

time to focus on AMSAT requirements. Paying a firm to do the work ensures more timely deliverables but AMSAT pays for the "privilege." Given the importance of the AMSAT website and that we need updates/enhancements done sooner rather than later, we've decided to work with a website provider that focuses on startups and not-for-profits in order to get our website fully functional more quickly. We're fortunate that Joe Fitzgerald, KM1P who is leading our AMSAT website effort, has been in communication with a firm, asking that they evaluate what is required to optimize our current website. For a small investment, we're hopeful that the end result will be a significant enhancement that will allow our volunteers to subsequently provide updates and new materials to our website as needed.

Stay tuned as we continue efforts to make the AMSAT website more "AMSAT friendly" and valuable as a resource for our members and others interested in amateur radio in space. 

AMSAT Logo at Dayton Hamvention 2013



Call for Volunteers for the AMSAT Booth at Dayton 2013

You can assist AMSAT by volunteering to help staff the booth. While there, you will meet other AMSAT members, interact with the satellite designers, builders, and operators, and enjoy all that Dayton has to offer. Steve Belter, N9IP is this year's lead on AMSAT's Dayton Operations at Hamvention. Please send an e-mail to Steve Belter, n9ip@amsat.org, if you are willing to help AMSAT at the Hamvention.





AMSAT-UK

<http://www.amsat-uk.org/>

AMSAT-UK will be providing a FM transponder and a BPSK telemetry beacon for the European Student Earth Orbiter (ESEO). This is the third mission within the European Space Agency's Education Satellite Programme.

The satellite will have a mass of 40 kg, measures 33x33x63 cm and is planned to launch in 2015-16 into a low Earth orbit. In addition to the AMSAT-UK FM transponder it is planned for ESEO to carry payloads operating at UHF and S-Band.

Nine European universities will be working with the prime contractor ALMA Space, Italy, on the mission. Cranfield University in Bedfordshire will be supplying a small sail that will be deployed to demonstrate the de-orbiting of spacecraft at the end of the mission.

The primary purpose of the AMSAT-UK payload is to provide a downlink telemetry that can be easily received by schools and colleges for educational outreach purposes. The data will be displayed in an attractive format and provide stimulation and encouragement for students to become interested in all STEM subjects in a unique way.

The target audience is primarily students at both primary and secondary levels and the project includes the development of a simple and cheap "ground station" operating on VHF frequencies in the Amateur Satellite Service. This station is an omni-directional antenna feeding a FUNcube Dongle PRO+ SDR receiver which will receive the signals direct from the satellite and transfer the data to specially developed graphical software running on any Windows laptop.

The project will include the development of suitable software to enable the display of the telemetry data and orbital tracking/prediction information and actual satellite attitude in an interesting and lively way.

The display software will be developed in collaboration with teachers and will be available in different "flavours" to accommodate a variety of age groups. In addition to displaying the telemetry, the software will also have a live "tracking map" display with predictions for the particular school location and be capable of visually showing the spacecraft attitude and spin rates etc.

The payload will also enable the uploading (indirectly via a moderated host) of short greetings messages for schools to use and the deposition of the data received by a school on a central database. This central data will also be available to be retrieved by schools for display and analysis.

AMSAT-UK envisage that inter-school competitions for, say, the most data collected in a period, the most inventive use of the data, or reports of "lessons learnt" from different age groups could be easily established with prizes and presentations.

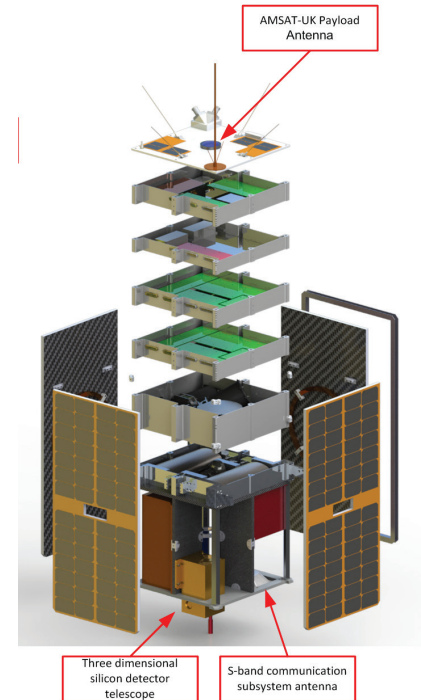
The secondary purpose of the payload is to provide a transponder for use by individual radio amateurs around the world at night or during holiday periods. This transponder would be a single channel system using FM modulation for the 23cm uplink and 2m downlink.

For schools the ground segment will typically consist of a turnstile (crossed dipole) antenna with an active filter. This will feed the 145MHz downlink signal to a FUNcube Dongle SDR PRO receiver which plugs into any Windows PC or laptop. Using such equipment, the link budget will be sufficient to enable reception of signals at a satisfactory level on all passes where the elevation exceeds 15 degrees.

For radio amateur users, similar simple equipment will suffice to listen to the FM voice downlink. Those users who wish to uplink signals will require about 100 watts EIRP e.g. 10 watts to an 8 element Yagi.

To display the telemetry, suitable display software will be developed together with a central data warehouse to enable schools to access data from prior orbits over the Internet.

The AMSAT-UK team will also assist the development of the software for schools and support the creation of teacher aids and lesson plans to ensure the best possible benefits for school students.



ESEO payload configuration with the AMSAT-UK antenna marked – The image was taken from the ESA website and is Copyright ALMA Space http://spaceimages.esa.int/Images/2013/01/ESEO_payloads_configurations

ESEO on the Web

http://www.esa.int/Education/ESA_student_satellite_takes_important_step_towards_space

About AMSAT-UK

Founded in 1977 AMSAT-UK is a voluntary organisation that supports the design and building of equipment for amateur radio satellites.

The organisation has developed the ground-breaking FUNcube satellite designed to encourage young people to learn about radio, space, physics and electronics. This is expected to launch during 2013.

They have also supplied an educational outreach subsystem for the UK Space Agency's first satellite UKube-1 planned to launch in 2013. 



An Equatorial Antenna Mount - Simple One Axis Tracking for Handheld Antennas

Rick Tejera, K7TEJ
SaguaroAstro@cox.net

When I first started on the birds July 2010, I learned very quickly that I didn't have enough hands to hold the antenna, tune the radio, copy call signs and key the mike. I also realized that my arms were getting a workout holding the antenna (I had made a homebrew dual band yagi from Kent Britain, WA5VJB, plans and built it a built heavier than I thought it would be!). So I started thinking about a way to hold the antenna that would allow me to point it without the arm strain and free up a spare hand. I happened to take a look on the patio and noticed my old equatorial telescope mount that I wasn't currently using. The wheels began to turn. I figured that I could align the mount in such a way that an antenna mounted to it would follow the bird with only one axis of motion. The result is the mount I describe here and so far it works quite well and I'm pleased with the results.

The Concept

First, before I talk about how the mount was built, a slight detour on telescope mounts is in order. There are essentially two types of telescope mounts, at least in regard to the mounts motion: 1) Alt-AZ and 2) Equatorial. The Alt-Az mount is really nothing more than a tripod with the scope mounted on top. The motion is exactly the same as an Alt-AZ Rotor. In order to track an object in the sky as it moves (due to the rotation of the Earth), you have to make adjustments in both Azimuth & Elevation (Altitude). The equatorial mount eliminates one axis of motion by aligning one axis parallel to the Earth's axis (the polar Axis). By then rotating the telescope around the Polar axis, in the opposite direction of the earth's rotation and at the same speed, the scope will follow whatever object you have in the eyepiece.

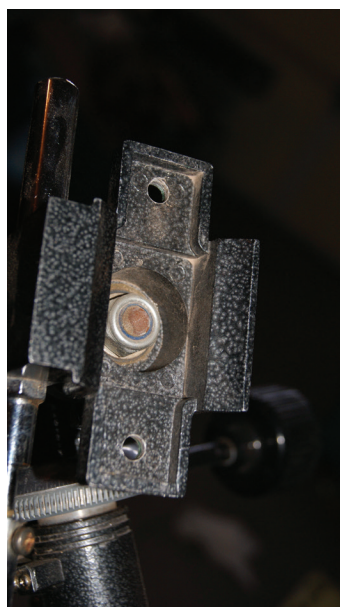
So how does this apply to tracking a satellite? Well if you consider the satellite's path as equivalent to the Earth's equator, one can line the mounting up so that the polar axis is normal to the path of the bird and align the polar axis along the azimuth of the greatest elevation and then the mount will swing around the polar axis in an arc that is the same as the satellite's path across the sky. Take the telescope off and substitute an antenna and you have a simple, yet effective method of tracking the bird during a pass.

Construction

OK, being an amateur astronomer as well



(above) Figure 1: The mount after the telescope mounting plate has been removed.



(left) Figure 2: The mount head with the telescope mounting plate removed.



(below) Figure 3: The Angle bracket. The left side (with the bolts for the corner brace) will attach to the mount head. The antenna attaches to the bottom side. The holes match up with the holes in the corner brace.

as a ham, I just happened to have a spare mount I wasn't using. So where can one get an equatorial mount without breaking the bank? Like most things, telescope mounts range from cheap to "If ya gotta ask, you can't afford it". Fortunately for our purposes, cheap is preferred. Low end mounts don't have electronic go to systems and are relatively small and light (at least as telescope mounts go). The mount I used is an Orion telescope tabletop EQ mount. This mount is just the head and does not include a tripod, and can be had from Orion for about \$70.00 (<http://www.telescope.com/Mounts-Tripods/Equatorial-Mounts-Tripods/Orion-Min-EQ-Tabletop-Equatorial-Telescope-Mount/pc/-1/c/2/sc/34/p/9055.uts>). Their EQ-1 Mount is the same head, with a tripod and goes for about \$130.00 (<http://www.telescope.com/Mounts-Tripods/Equatorial-Mounts-Tripods/Orion-EQ-1-Equatorial-Telescope-Mount/pc/-1/c/2/sc/34/p/9011.uts>). One can usually find cheap EQ mounts at garage sales or on astronomy bulletin boards. E-Bay & Craigslist would also be good sources. You could also contact your local astronomy club and ask for advice. You'll also need some 3/16" aluminum angle stock.

So, let's get on with it. I'll be describing the process as I made mine, but like most things, feel free to adapt to your mount & abilities. With the EQ-1 the first step is to remove the telescope mounting plate. Undo the two screws on the bottom of the plate and off it comes. You should now have just the head with the flat part where the mounting plate was (see figures 1 & 2).

Lay the angle stock in the channel parallel to the long axis of the mounting plate attach point and mark it where the two screw holes are. Also, mark the end of the mounting plate attach point. Cut the angle stock where you marked the end of the attach point. Important! Cut the only the side of the angle stock opposite from that of the mounting holes (Trust me I actually made this mistake not once, but twice.). Bend the angle stock to a right angle (see Figure 3). My first iteration of the mount eventually fatigued at the bend, so when I rebuilt it, I added a stainless corner brace to the assembly. This adds much needed strength at this weak link. Drill the holes for the mounting screws and test fit. The length of angle that will hold the antenna should be parallel to the declination axis (That's the one with the big counter weight) and should be long enough to hold your antenna's handle. Once satisfied with the fit, place the antenna's handle in the crook of the angle stock (it should be pointing away from the counterweight) and drill two (or more if

needed, though I doubt you'd need to) holes to hold the antenna to the mount. I drilled one hole in each side of the angle, about 3 inches apart, this seemed to help stiffen the assembly. You can now reattach the angle to the mounting plate attach point using the screws that held the mounting plate. You may have to substitute longer screws depending on the materials you use. Once that's done, mount the antenna to the tail of the angle stock. I used 1/4 x 2" wing screws & bolts. This makes set up a quick & easy, tool-less endeavor, a plus for the portable operator. You're now ready to operate! See figures 4 & 5 for the completed mount.

Setup

OK, we're ready to operate, but first we need to align the mount with the satellite's orbit. To do so, we need a few bits of information: 1) the maximum elevation of the pass, and 2) the azimuth, where that max occurs. For this I use either SatScape or WinList (part of the SatPC 32 package).

Once armed with the pointing details, the first order of business is to set the latitude scale to 90 Deg MINUS the max elevation. So if the max elevation of the pass is 55 degrees, set the latitude scale to 35 degrees. The reason is simple. The latitude scale is the angle to the pole if you imagine the orbital path as the equator. So the angle of the pole above the horizon is always the compliment of the elevation of the equator. Once you set it up, you'll see what I mean and it will become clear.

Once the elevation is set, you now need to point the mount along the azimuth of max elevation. Rotate the antenna so it is at the max elevation (it should be parallel to the declination shaft and pointing away from the counterweight. Point the antenna in the general direction of max elevation. I use an orienteering compass to refine the pointing. Remember to account for magnetic declination. Form my QTH in DM33 that's 12 degrees east, which means I subtract 12 degrees from my max elevation azimuth to get the proper compass bearing. If your declination is west, you'd add the appropriate amount. You shouldn't need to get too accurate as most of our antennas have sufficient beamwidth to accommodate small pointing errors. OK, all that's left is to hook up your antenna to your radio and wait for AOS!

Working It

Now that you're set up, before the bird comes over the hill, check to see that the



Figure 4: The mount attached to the head. The antenna will mount to the other end and point towards the camera.



Figure 5: The antenna attached to the mount. Set for a high elevation pass.

range of motion around the polar axis follows the path the bird will take. Rotate the antenna so it is parallel to the ground in the direction the bird will rise; you'll see it should be pointing at the spot your prediction software says the bird will rise. Move it along the path and you'll see how it follows the track of the satellite quite nicely. You can use the slow motion control to track, but to be honest I usually just set the lock screw just tight enough to hold the mount steady while allowing me to move the antenna by hand. Now I keep talking about rotating about the polar axis to track the bird, but do we need the other axis (Declination, in astronomy terms)? Well, short answer: Yes. I use the Dec Axis to adjust the antenna for changing polarity. Again one could use the slow motion controls, though this is limited as most EQ mount have limited range of motion in this axis, maybe about 10 degrees on either side of center. What I do again is use the set screw on this axis to just hold the antenna in place but loose enough to allow me to turn it as needed.

OK, it's AOS, let get tracking. As the bird rises I use the radar plot on my I-pod to keep track of the bird's position. I'll slowly move the antenna to track until I hear the bird. Once I have the bird, I'll then rotate the antenna in the dec axis to change the polarity to get the best signal. Now I'm ready to transmit. I'll move the antenna to follow the bird about every minute or so, certainly, you'll know if you forgot to move it when the signal goes away! (I've done that more than once, while busy working a bunch of stations). Just swing it a bit further until the signal returns. Keep adjusting for polarity as needed. Some birds are more tolerant of polarity errors than others (SO-50 is the least tolerant; you'll be twisting the antenna a lot while working SO-50).

It'll take a pass or two to get used to the operation of the mount, but once you do, you'll find it a lot easier on the arms than the "Armstrong Method".

Future Refinements

Am I happy with the results? Yes, but like most things there is room for improvement. One possibility is to motorize the mount. Personally, that is probably beyond my expertise, but I'm quite certain many readers would find this a simple task, feel free to experiment, I'd be interested in any projects to motorize the mount. I'd think it should be possible to drive the mount from your tracking software or an LVB tracker; the possibilities are limited only by one's imagination.



Figure 6: The antenna set for AOS with horizontal polarization.



Figure 7: Max Elevation

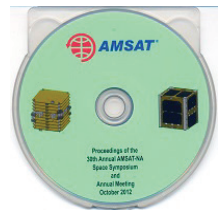


Figure 8: LOS

If you do improve on my idea, please let me know, I'd certainly be interested to see how far this can be taken.

Feel free to contact me with any questions or comments you may have about this project. Also I'd like to see pictures of your version. I can be reached at: SaguaroAstro@cox.net.

73
Rick K7TEJ



The **Proceedings of the AMSAT-NA 30th Symposium** and AMSAT-NA Annual Meeting, October 26-28 in Orlando, Florida are available in the on-line AMSAT Store.

Please visit the store at:
<http://store.amsat.org/catalog/>

The proceedings contains over 30 articles on subjects ranging from current satellite operations to updates on the Fox Project.

If you could not make the meeting, this is a great source of the latest information. Price is \$25 each + \$12 shipping for the book, \$5 shipping for the DVD for USA. Order your copy today!



This year marks Martha's 35th year of working at AMSAT-NA. On behalf of all AMSAT members ... thank-you and congratulations on this milestone! Here is the original announcement from the June 1978 AMSAT Newsletter (when it was typed by hand)

INTRODUCING MARTHA - AMSAT'S ADMINISTRATIVE ASSISTANT

If you've had occasion to telephone the AMSAT Washington office in the past several months and been greeted by a friendly female voice, then chances are you know of Martha Saragovitz, AMSAT's Administrative Assistant.

Martha joined AMSAT fulltime in January after ten years as a Supervising Teacher with the Head Start Program. She has helped significantly to reduce the burden of paperwork on AMSAT's volunteer and paid staff. Martha's responsibilities include handling the large volume of AMSAT mail, and processing of membership renewals, life memberships and follow-up notices. She also does most of the AMSAT bookkeeping and accounting, and also AMSAT typing, including the typing and distribution of AMSAT Newsletters.

A native of Washington where she has an apartment near Dupont Circle, Martha describes here interests this way:

"I enjoy the ballet, theatre, travel and reading. I hope to continue to use my background in education by doing volunteer work."



... Excerpt about Martha from Chapter 7 of the 40th Anniversary book by Bill Tynan, W3XO, and others put together for the 2009 Space Symposium ... Martha Arrives ...

By 1978, AMSAT membership had grown such that Perry Klein was no longer able to keep up with the administrative paperwork by himself. From a couple who lived in his building, he learned that their daughter, though employed as a teacher in DC's Headstart program, was willing to work part time. That's how Martha Saragovitz came to AMSAT. Martha remains our sole full time paid employee.

Incidentally, Martha met her husband, John Shew, N4QQ, as a result of her association with AMSAT. So, AMSAT can be credited with fostering a romance.

Of course, over its 40 years, it has come close to fostering a few divorces as well.

At first, Martha worked in Perry's bedroom, which raised a few eyebrows. When Perry bought the adjoining apartment, the AM-

SAT's office function was moved into that space. However, Perry's in-laws frequently visited and stayed in the second apartment. So, more than once, Martha arrived at work to encounter strange people, still in their pajamas.

But, after over two years of working first in Perry Klein's bedroom, then in his adjacent apartment, and later keeping company with a washer and drier in Marie Marr's basement, much more satisfactory office space was found at 850 Sligo Avenue, Silver Spring, Maryland.

My congratulations and gratitude to Martha for her 35 years of being the glue which holds AMSAT together. From the newest member to old timers, she is always there with information, help, and wise advice.

Alan Biddle, WA4SCA, AMSAT Board Member and Corporate Secretary



First: Martha Saragovitz at the registration table during the 2012 Symposium; also pictured L to R: Keith Baker, KB1SF, Roberta Cohen, WA2FRW, Mort Cohen, WA2ARS, Lou McFadin, W5DID (AA4KN photo)

Barry Baines, WD4ASW - President AMSAT-NA - wd4asw@amsat.org

The purpose of this article to put into perspective various overly optimistic and erroneous reports in the amateur radio press that changes to the International Traffic in Arms Regulations (ITAR) law has removed restrictions on AMSAT-NA and the educational community developing satellites. It is true that ITAR classified even amateur radio and student-built satellites as “munitions”, hence restricting U.S. citizen’s interactions with foreign individuals or organizations for cooperation and sharing expertise. However, it must be recognized that the announced changes due to Congress passing the National Defense Authorization Act for Fiscal Year 2013, Section 1261 (“Removal of Satellites and Related Items From the United States Munitions List”) and related sections pertaining to export control significantly change U.S. satellite export policy that will require some time for completion. Until the new procedures are implemented, AMSAT-NA continues to be subject to the current ITAR regulations.

AMSAT Cannot Get Around ITAR

Mention in the amateur radio press that AMSAT found a way to “get around ITAR” when we published the Fox-1 satellite specification as public domain and are developing the software and hardware as open source is misleading.

Clearly, no US-based organization or US citizens can “get around” ITAR. We are expected to fully comply with all provisions of ITAR and AMSAT has been meticulous about following the letter and intent of the law. Indeed, we spent considerable time (and legal expense) to ensure that our leadership is fully aware of our responsibilities under ITAR to ensure that we do not violate any of the ITAR provisions now or in the future.

One of the provisions of ITAR is that technical information that is placed in the public domain is exempt from ITAR restrictions on sharing information with foreign nationals. The key question is how such information is initially placed in the public domain. Based upon specific guidance we requested from the US Department of State’s Directorate of Defense Trade Controls (DDTC) in 2009, in February 2010 we were informed that the proper way to place such information in public domain is to physically publish such materials in publications “generally accessible or available to the public,” which in our case

means such venues as the “AMSAT Journal” or the “Proceedings of the AMSAT Space Symposium.” Simple placement of such materials on websites or other electronic distribution is not sufficient; documents must be physically published and made available to anyone wishing to obtain them through subscription or other means of purchase. Consequently, the “Proceedings of the 30th AMSAT Space Symposium and Annual General Meeting” contains a number of papers and supporting documentation detailing “Project Fox.” The “Proceedings” containing Fox-1 materials were distributed in printed form to registered attendees of the AMSAT Space Symposium and copies are available from the AMSAT office for a purchase price. We took this approach to be in compliance with ITAR and such steps certainly don’t allow AMSAT to “get around” ITAR requirements. Publication of such materials then means we can publicly discuss those aspects of the Fox Project that are thus placed in public domain and this allowed our engineering presentations to take place at the 2012 AMSAT Space Symposium and future venues (such as the Dayton Hamvention) where foreign nationals may be in attendance.

Second, publication of papers is done “after the fact.” Something must first be developed and a paper is then written detailing the findings. Until physical publication actually takes place, we cannot discuss the technical issue in question with foreign nationals; otherwise, we’d be in potential violation of ITAR. Consequently, we cannot collaborate with other AMSAT organizations (or “non-US amateur radio operators”) since “work in progress” is by definition technical material not yet placed in public domain through printed publication. Indeed, ITAR defines such exchanges as “deemed exports.” This inability to interact with other AMSAT organizations on developing technology is the key impediment of ITAR towards collaboration on satellite projects and these restrictions still apply to AMSAT and our engineering volunteers. Placement of materials in public domain allows us to discuss the Fox-1 project in public forums, but it does nothing to address our preference to work with other AMSAT organizations on joint projects. Thus, ITAR continues to prohibit AMSAT from working with other AMSAT organizations on satellite projects and placement of materials in the public domain through printed publication does not address this restriction.

What Still Needs to be Done

The amendments that are included in the National Defense Authorization Act restores the authority to the President to exercise discretion whether to transfer “less sensitive” satellites and space-related items from ITAR (US Munitions List) administered by the Department of State’s Directorate of Defense Trade Controls (DDTC) to the Commerce Control List (under Export Administration Regulations) administered by the US Department of Commerce. This would eliminate much of the onerous provisions of ITAR. Note that Congress has not made the determination to actually make this transfer; the President must make this decision and then notify Congress.

Before the President makes that determination, the Department of State’s Directorate of Defense Trade Controls (DDTC)-which administers ITAR along with the Department of Commerce-which administers Export Administration Regulations- is expected to release proposed rules that will be published in the “Federal Register” detailing the scope of the proposed transfer as well as the details of how this transition will take place. AMSAT will be examining this process closely to ensure the wording includes provisions for amateur radio and educational satellites are included in the proposed transfer to Export Administration Regulations. After the proposed rule making is released, a period for public comment is expected, and once input is received a “final” set of rules will be published. Once that is done, the President will presumably make a determination whether to transfer items to Export Administration Regulations and Congress will be formally notified of the items to be transferred with a 30-day notification period before actual removal of items from the USML to give time for congressional response. We then expect a six-month period of “transition” will take place to ensure exporters and the US Government have adequate systems in place to comply with the new requirements before implementation of the new rules.

Consequently, the impact of ITAR on amateur radio satellite construction in the US remains in effect until the President makes a decision and new rules are actually implemented. It isn’t unreasonable to expect that this process will last into 2014.

Please note that if US non-military satellites are transferred to Export Administration



Regulations, they would still be considered subject to US export control with an export license required to physically ship an amateur radio satellite (or components) overseas. This was the case before ITAR became law.

The key difference between Export Administration Regulations and ITAR is that ITAR also includes “deemed exports” which is the technical exchange of information through any means of communication, such as e-mail, telephone conversations, direct interaction privately or in meetings, mailing of documents, faxes, etc. Simply talking about the technical details without physical export of the technology item is prohibited for items on the US Munitions List that are subject to ITAR unless a “Technical Assistance Agreement” (TAA), approved by the Directorate of Defense Trade Controls (DDTC) exists between the US entity and foreign nationals involved. For a variety of reasons, a TAA is not possible between

AMSAT and other AMSAT organizations, so it is not possible under ITAR for AMSAT in the US to have any technical interaction with an organization composing of foreign nationals. In addition, ITAR also has administrative provisions that requires detailed accounting of ALL interactions with foreign nationals concerning “deemed exports” even when there is a TAA involved. Failure to properly manage the administrative process can result in substantial penalties even though no transfer of inappropriate information actually took place.

Under Export Administration Regulations, such technical discussions are permitted without restrictions or with the need to document such interactions. This opens the possibility of technical collaboration that we’re seeking. There is still the requirement for an export license for the shipment of the physical item in question. Under this approach, it is possible for AMSAT to collaborate with other AMSAT organizations

on development of amateur radio satellites and then, as a registered exporter of communication satellite technology, to obtain an export license to physically ship the associated item(s) overseas to countries that are not prohibited from receiving them.

It is the commercial impact of ITAR on US manufacturers of commercial satellites that is the driver behind the desire to remove these satellites from ITAR. ITAR places US producers in a non-competitive position versus foreign manufacturers who can produce “ITAR-free” products. As the process of transition is defined, AMSAT must remain vigilant that the wording of the proposed rules makes clear that amateur radio-based satellites as well as satellite built by educational institutions are included in the group of “less sensitive” satellites and space-related items that are to be considered candidates for transfer from ITAR to Export Administration Regulations.



Merritt Island High School Mission Selected for NASA Cubesat Launch Initiative

The fourth round of selections in NASA’s CubeSat Launch Initiative also included a team of high school students at the Merritt Island High School in Brevard County, Florida. They plan to build a cubesat containing two accelerometers to measure the amount of vibration in the Poly Picosatellite Orbital Deployer, or P-POD case that holds the cubesats during launch and then deploys them.

The high school is partnering with students at California Polytechnic State University in San Luis Obispo. The Cal-Poly CubeSat, dubbed CP9, is actually two cubes that contain accelerometers, plus a radio to transmit data back to Earth for the high school students to analyze. The Merritt Island High School cubesat, named StangSat, will stream data to the CP9 in real time during the launch using Wi-Fi.

“We’re going to be demonstrating that wireless transmissions inside the P-POD aren’t going to harm the launch,” said Adam Darley, a senior at Cal-Poly who is serving as the CP9 project manager. “If we can demonstrate that, then it will act as a platform to being able to stream information without a radio link.”



Story credit: Information Week, <http://www.informationweek.com/government/mobile/nasa-to-send-cube-satellites-into-space/240149818>

The StangSat Team is on facebook at:
<https://www.facebook.com/pages/MIHS-CubeSat/110920062311996>



Photo of the combined MIHS, Cal Poly, and NASA teams as they did their first integrated testing of the StangSat satellite at Kennedy Space Center.

**Merritt Island High School
CubeSat Fundraiser
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The High School Team held a recent fundraiser to help fund their project



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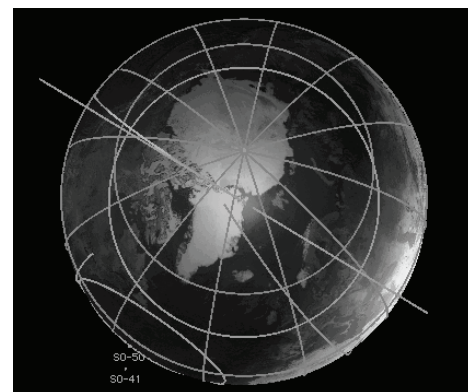
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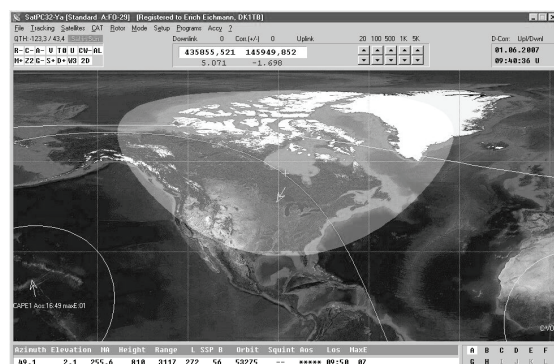


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